SELF-KNOWLEDGE OF DEFICITS AND SELF-CONCEPT FOLLOWING SEVERE CLOSED HEAD INJURY

By

RUSSELL R. ADDEO

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1995

ACKNOWLEDGEMENTS

This project would not have been possible had it not been for a large number of people generous enough to assist in my efforts. I would like to thank my chairperson, Bruce Crosson, Ph.D., for his consistent theoretical, editorial, and personal support during this project. He provided an integrated model of an astute and sensitive clinician combined with the skill, rigor and clarity of an adept investigator. These qualities and their integration are those that I seek to emulate. I would also like to thank all of my other committee members (Russell Bauer, Ph.D., Cynthia Beaulieu, Ph.D., Walter Cunningham, Ph.D., Eileen Fennell, Ph.D., Anthony Greene, Ph.D., Michael Crary, Ph.D.) for their time and thoughtful conceptual, methodological, and statistical advice.

I would also like to thank the staff of Memorial Rehabilitation Hospital (currently Genesis Rehabilitation Hospital). The foremost acknowledgement should go to Cynthia Beaulieu, Ph.D. Without her unfailing support and significant investment of time in this study, it would not have been completed. Her dedication to this project and in my professional development are deeply appreciated. Special thanks should go to the Occupational therapists who completed the questionnaires and to the psychology staff who assisted in

the data collection. Those that also contributed their time were Charles Schauer, Ph.D, and Travis White, Ph.D.

I would like to thank the staff of Transitions of Long Island and Long Island Jewish Medical Center in New York. I would like to specifically thank Deborah Benson, Ph.D., Jack Rattock, Ph.D., and William Barr, Ph.D. for allowing access to the patients. I would also like to thank the life skill trainers for completing the questionnaires.

A project of this scope is not possible without the help of loved ones. Therefore, I would like to thank Lisa Barbarette and my family for their understanding and emotional support during the course of this project.

Special thanks should go to the patients that were willing to participate in this study. I admire their courage and determination in the face of the many obstacles they confront. I hope that this study will ultimately help them in their struggle.

TABLE OF CONTENTS

BIOGRAPHICAL SKETCH

Russell R. Addeo was born on November 26, 1962, in Queens, New York. He obtained his Bachelors degree in Psychology from Florida Atlantic University in May, 1989. He entered the University of Florida in August, 1989, as a graduate student in the Department of Clinical and Health Psychology. He obtained his Masters degree in December, 1991. His masters thesis investigated the construct validity of a self-esteem measure. Following graduation in August, 1995, he will be employed as a neuropsychologist at Genesis Rehabilitation Hospital in Jacksonville, Florida.

Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

SELF-KNOWLEDGE OF DEFICITS AND SELF-CONCEPT FOLLOWING SEVERE CLOSED HEAD INJURY

By

Russell R. Addeo

August, 1995

Chairperson: Bruce Crosson, Ph.D.
Major Department: Clinical and Health Psychology

People that suffer severe closed head injury (CHI) demonstrate a number of deficits, such as unawareness of deficits, denial, low self-esteem, and psychological distress, which ultimately affects their ability to function during rehabilitation and after discharge. Investigators suggest that as patients become more aware of their deficits, self-esteem decreases, and psychological distress increases. The purpose of the current investigation is the experimental analyses of some of these assumptions.

A path model is proposed which specifies the relationship between cognitive deficits (CD) thought to underlie awareness deficits, denial, comparative self-knowledge (CSK), current and premorbid self-concept/self-esteem (SCSE), and psychological distress. From this larger model the experimental path analysis model investigated the relationship between CD, denial, CSK and three different dimensions of SCSE (cognitive, social and physical).

Fifty-seven severe CHI patients undergoing rehabilitation were studied. Hierarchical multiple regression was used to calculate the path coefficients. Path analysis modeling was utilized to test the model predictions. Results confirmed the prediction that CSK would have a direct effect upon each of the dimensions of the SCSE (cognitive, social, and physical; path coefficients were -.49, -.34, and -.35, respectively). Greater CSK resulted in lower SCSE. Also confirmed was the prediction that CD would be unrelated to denial. The predictions that CD and denial would have independent and direct effects on CSK were not met. The results for the social and physical SCSE were similar. There were significant and direct effects from CSK to social and physical SCSE. Therefore, increased knowledge of deficits is associated with reduced perceptions of their social competence, physical abilities and appearance. Analysis of the cognitive SCSE model found that CSK and CD had direct effects upon cognitive SCSE, with possibly additive or opposing influences. This suggests that greater CD and greater CSK result in lower cognitive SCSE.

A major thesis of this study, that the level of CSK influences patient SCSE, was confirmed. Suggestions for how to increase CSK while maintaining self-esteem are discussed along with the limitations, future directions and implications for rehabilitation of the current study.

INTRODUCTION

During treatment for closed head injury, rehabilitation therapists are faced with different degrees of patient non-compliance with treatment and psychological distress. Frequently, noncompliance and the presence or absence of distress are related to how aware the patients are of their deficits, which can be due to neurologically mediated awareness deficits or psychological denial. However, the individual contributions of each of these conditions is often not known. Psychological distress is most often expressed in anxiety, depression, and anger. Therapists must often walk a fine line between helping head injury patients become more aware of their deficits, which may negatively impact self-esteem, and trying to maintain self-esteem at a high enough level that patients have the confidence to accept the psychological risks inherent in rehabilitation (Deaton, 1986). On the one hand, if patients do not recognize their deficits, they will be unable to compensate for them and may not be motivated for rehabilitation at all. On the other hand, lowered self-esteem can increase vulnerability to psychological distress, which can emotionally immobilize the patient and thwart rehabilitation efforts. Because there is such a delicate balance between awareness, self-esteem, and

psychological distress, it is critical to understand these variables in the head-injury rehabilitation environment (Bergquist, & Jacket, 1993; Deaton, 1986).

The purpose of the current investigation is to provide a model which describes the relationship between awareness, self-concept, and psychological distress. Experimental hypotheses will be made for the portion of the model which is concerned with cognitive deficits (indirectly awareness deficits), denial, comparative self-knowledge, and self-concept. However, in order to understand how the patients responds to their deficits, we must first understand the nature and cause of their deficits, particularly some of the neurological, cognitive, and psychosocial consequences of closed head injury.

Neuropathophysiological Mechanisms

Closed head injury (CHI), one form of traumatic brain injury, refers to nonmissile impact of either a moving object on a relatively stationary head or the head being decelerated by a relatively stationary object (Levin, Benton, & Grossman, 1982). Levin et al. (1982) outline several primary and secondary injuries which result from CHI. Among the primary injuries which result from the immediate impact are macroscopic and microscopic lesions.

Macroscopic lesions include contusion to the underlying site of impact, coup and contrecoup lesions (which often occur

to the ventral portions of the frontal and temporal poles; Adams, & Victor, 1989; Lezak, 1983; Prigatano, 1991), and possible laceration from depressed skull fractures. Other common sites of macroscopic lesions include the corpus callosum and superior cerebellar peduncles which are frequently the site of hemorrhagic lesions.

Widespread shearing/stretching of nerve fibers causes diffuse microscopic lesions which primarily result in axonal damage and impaired axonal metabolism (e.g. retraction balls and axonal swelling; Povlishock, & Coburn, 1989). Shear strains are usually the result of rotational acceleration of the brain on its axis (Holbourn, 1943). Other types of focal injuries include lesions to the cranial nerves which result in specific sensory-motor losses or hypothalamic-pituitary lesions which can result in diabetes insipidus, depression, psychomotor retardation, and diminished sexual functioning.

Intracranial space is occupied by blood, brain and cerebrospinal fluid. Some of the secondary mechanisms which can result in injury such as intracranial hemorrhaging, edema (increased tissue fluid volume) and diffuse brain swelling, compression ischemia, raised intracranial pressure, and herniation are related to the physics of intracranial space. Hemorrhage is the result of ruptured blood vessels and may result in epidural, subdural, or intracranial hematomas. The presence of blood in the neuronal extracellular fluid inhibits neuronal metabolism and results in neuronal death. Subdural

and epidural hematoma cause increased pressure on the underlying tissue, which may cause compression ischemia. Intracranial hematomas frequently occur in orbital frontal and temporal lobe regions (Jennett & Teasdale, 1981). Cerebral edema refers to the increased tissue fluid volume, which may be the result of either vasogenic or cytotoxic factors. Studies suggest that as cerebral edema resolves, large areas of lesioned cerebral white matter are found due to the destruction of myelinated axon sheaths. Ischemia may result directly from decreased blood flow due to raised intracranial pressure, ruptured arteries, and pulmonary and cardiac insufficiency. Increased intracranial pressure may result from hematoma or generalized swelling and high levels are usually associated with brain herniation. Herniation occurs when intracranial pressure exceeds the buffering capacity of cerebrospinal fluid. The most common site of herniation is transtentorial or uncal herniation. This occurs when a supratentorial mass exerts a downward force on the uncus and parahippocampal gyrus on to the tentorium, third nerve, cerebral peduncle and midbrain reticular activating system. Symptoms typically include third nerve palsy, hemiparesis and loss of consciousness.

In addition to the primary and secondary causes of injury, there are delayed effects which impair brain function. Post-traumatic hydrocephalus (abnormal increase in amount of cerebrospinal fluid) may result from obstruction of

cerebrospinal fluid (communicating or obstructive hydrocephalus), or atrophy of white matter (ex vacuo hydrocephalus; Levin et al., 1982). The etiology of normal pressure hydrocephalus is as yet unknown but the results are often progressive dementia, impaired gait, and incontinence (Reitan & Wolfson, 1986). Posttraumatic epilepsy may also occur following head-injury, and usually occurs around areas of the brain that have scars, cysts, abscesses, and other pathological sequelae of trauma.

From the preceding review one can surmise that heterogeneity of brain injury is the rule rather than the exception. However, certain types of impairments are particularly common. Mechanical shearing of nerve fibers and blood vessels are the most common mechanisms of diffuse brain injury followed by contusion, swelling, and hemorrhaging. The foregoing damage frequently results in loss of consciousness and coma, post-traumatic amnesia, residual deficits in memory, attention, awareness, executive functioning, and paresis. Some investigators have suggested a possible relationship between the preponderance of frontotemporal lesions in CHI patients and the incidence of awareness deficits (e.g. Prigatano, 1991).

Cognitive and Psychosocial Consequences of CHI

Head injuries are increasingly being recognized as a major health problem in the United States, due to the number

of injuries as well as to the costs involved in medical and rehabilitative care. Estimates run as high as eight million head injuries recorded annually in the United States (Conboy, Barth, & Boll, 1986). Of these approximately one million suffer head injuries severe enough to warrant hospitalization, approximately 15,000 of which are Floridians (National Head Injury Foundation, 1991). Statistics reveal that head injuries are most common for those 10-30 years of age, with males outnumbering females by more than 2:1 (Bond, 1986).

Due to the advances of modern medical science and technology, increasing numbers of head injury patients survive (Adams, & Victor, 1989; Kreutzer, & Wehman, 1991). However, with survival the patient (and family) must face drastic and often devastating alterations of their lives, including changes in cognition, personality, social and familial relations, physical functioning, and occupational prospects (Crosson, 1987; Lezak, 1988; Adamovich, 1991; Kreutzer, Devany, Myers, & Marwitz, 1991; Dikmen, Machamer, Winn, Temkin, 1995; Dikmen, Ross, Machamer, & Temkin, 1995).

Prigatano (1987) suggests that the interaction between the cognitive and affective sequelae of CHI is an area that deserves greater analysis because their combined impact is perhaps the most devastating consequence of CHI (Armstrong, 1991). For example, several investigators (Bond, 1986; Jennett, & Teasdale, 1981) reviewed studies which indicate that personality and intellectual impairments are more

strongly related to long term outcome than severity of neurological damage.

Common cognitive deficits following CHI include impaired intellectual abilities, memory, attention, executive functions, awareness, abstract reasoning, communication, and visuospatial functions (Adamovich, 1991; Bergquist, & Jacket, 1993; Bond, 1986; Conboy, Barth, & Boll, 1986; Dikmen, Machamer, Winn, Temkin, 1995; Lezak, 1983).

Approximately 60-72% of severe CHI patients also suffer emotional/personality changes as a result of CHI (Jennett, & Teasdale, 1981; Crosson, 1987; Lishman, 1978). Common personality changes include depression and anxiety (Hinkeldey, & Corrigan, 1990; Tyerman, & Humphrey, 1984), anger and aggressiveness (Gans, 1983), impulse control deficits (Crosson, 1987), irritability (Hinkeldey, & Corrigan, 1990; McKinley, Brooks, Bond, Martinage, & Marshall, 1981), denial (Crosson, 1987; Deaton, 1986), and low self-esteem (Johnson, & Newton, 1987; Klonoff, & Lage, 1991; Lewis, & Rosenberg, 1990; Tyerman, & Humphrey, 1984). Far from being a random sample of the population, CHI patients have a higher incidence of premorbid mood disorders, alcoholism, disturbed family life, antisocial practices, and learning disabilities (Jennett, & Teasdale, 1981; Kreutzer, & Wehman, 1991). Since there is greater premorbid psychopathology, one should expect greater personality problems during head injury rehabilitation.

Interest in awareness after brain injury has increased in the past 10 years (Hibbard, Gordon, Stein, Grober, & Sliwinski, 1992; Prigatano, & Schacter, 1991). Many studies suggest that self-esteem and self-concept are impaired following CHI (e.g. Tyerman, & Humphrey, 1984) and emotional distress is common (e.g. Crosson, 1987). As mentioned previously there is often a fine balance between self-esteem, denial, and psychological distress following CHI, which leaves the rehabilitation therapist to make sense out of these cognitive and emotional disturbances following CHI. Some investigators have provided valuable insights regarding the relationship between awareness of deficits, self-concept, and psychological distress following CHI (e.g. Code, 1986; Deaton, 1986; Fordyce, & Roueche, 1986; McGlynn, & Schacter, 1989; Newton, & Johnson, 1985; Prigatano, & Schacter, 1991; Tyerman, & Humphrey 1984). However, these constructs have not been evaluated systematically, and a theory relating them is lacking (Kihlstrom, & Tobias, 1991). This leaves many questions unanswered. For example, what is the relationship between unawareness and the self-concept?

The primary focus of the current investigation is to understand how awareness of cognitive, emotional, and physical deficits during rehabilitation is related to different facets of the patient's self-concept. The benefit of gaining a greater understanding of awareness and self-concept following CHI is the potential impact it has for the patients' emotional

status and their involvement in acute rehabilitation (Crosson, 1987; Deaton, 1986; Jennett, & Teasdale, 1981). In addition, it may also allow clinicians to understand when to discontinue treatment, which has important financial ramifications. If a patient is unwilling to engage in rehabilitation, attempts at persuasion usually fail. For example, if a once successful businessman has a severe anterograde memory deficit following a car accident, he may refuse to participate in cognitive rehabilitation for several reasons. He may simply be unaware that he has a memory problem due to the neurological impairment or he is attempting to avoid psychological distress inherent in recognition of deficits. The latter explanation, however, only scratches the surface regarding psychological denial and provides an incomplete understanding of the psychological status. In particular, the individual's self-concept and its impact upon his estimates of his ability must be considered. Perhaps, engaging in cognitive rehabilitation does not match his prior self-concept which described him as having an excellent ability to recall information. In fact, he may have been particularly impressed with his ability to speak extemporaneously at monthly board meetings, which his memory deficits would now preclude him from doing. This example dramatizes the dilemma which therapists face. They must institute strategies which will result in maximal independence; however, the treatment decision is not always clear. Should the therapist confront the patient with more

information, arrange planned failures, institute psychotherapy which focuses on change of self-concept, or plan for discharge? Because a failure to make changes in self-concept limits rehabilitation progress. These decisions have to be made every day in rehabilitation of severe CHI patients with dramatic consequences for patient outcome.

This dilemma also raises several important theoretical questions which have significant practical consequences. For example, how can neurologically mediated deficits in awareness be differentiated from psychological denial and what is the role of the self-concept in the development of denial? The present study hopes to specify the relationship between some of these variables as a step in addressing issues of awareness, denial, and self-concept after CHI.

The current investigation provides a theoretical integration of the virtually non-overlapping literature on awareness of deficits, self-concept, and psychological distress. The review of the literature is divided into four parts. The first section reviews the literature on awareness of deficit following brain injury, followed by a review of the self-concept literature. The third section discusses the interaction between awareness deficits, denial and self concept, and the final section reviews relevant literature on psychological distress following brain injury.

A model is presented which places the self-concept at a strategic locus with respect to the various cognitive and

emotional changes that result from CHI. The model considers the relationship between cognitive deficits (presumed to underlie awareness deficits), denial, self-knowledge and self-concept.

REVIEW OF THE LITERATURE

Awareness of Deficits After Brain Injury

A discussion of awareness of deficits after brain injury is particularly pertinent to CHI patients because of the consequences it has for adjustment to rehabilitation and eventual return to the community. Unawareness of deficits following brain injury creates difficulty progressing through programmatic rehabilitation and impairs the patient's ability to adjust to the dramatic changes in their physical, cognitive, social and occupational functioning (Crosson, Barco, Velozo, Bolesta, Cooper, Werts & Brobeck, 1989; Youngblood & Altman, 1989). As Prigatano (1991) suggested "severely brain-injured patients do not adequately perceive significant changes in their higher cerebral functioning" (p. 111), resulting in behavior problems which ultimately lead to alienation of loved ones and isolation. Prigatano and Fordyce (1986) suggested that unawareness is associated with poor psychosocial adjustment and poor motivation for rehabilitation. Several investigators confirmed that the level of awareness is the best predictor of successful treatment (Lam, McMahon, Priddy, & Gehred-Schultz, 1988), vocational outcome (Ezrachi, Ben-Yishay, Kay, Diller & Rattock, 1991) and psychosocial outcome (Prigatano, Altman &

O'Brien, 1990). Unawareness of cognitive and behavioral dysfunction represents the greatest single impediment to functional re-entry into society (Prigatano, 1986a).

Despite its importance, the literature on awareness of deficits after brain injury is fraught with terminological confusion due to the lack of a useful taxonomy which accurately describes empirical phenomenon (McGlynn & Schacter, 1989; Prigatano & Schacter, 1991). Brain injury can often result in unawareness of deficits that may be subtle ('I know about "those problems" ') or startlingly obvious ('Why do I have to go to cognitive therapy, my memory is fine'), either of which proves to be an obstacle to rehabilitation and post-rehabilitative adjustment. Impaired awareness of deficits can vary as a function of the type of deficit (e.g. physical or cognitive) or modality (e.g. vision). It can manifest itself in the patient's failure to institute behavioral compensations and in the patient's direct verbalizations (Weinstein & Kahn, 1955). Impaired awareness has been observed for memory impairments (Levin, Benton & Grossman, 1982; Sunderland, Harris & Baddeley, 1983), attention deficits (Allen & Ruff, 1990), personality changes (Fahy, Irving & Millac, 1967), blindness (Antons syndrome), hemianopia, hemiplegia, aphasia, and dementia (McGlynn & Schacter, 1989). Given that unawareness of deficits can vary in severity, modality, and type of deficit and manifest itself in either overt behavior (or lack thereof) or verbalization, it is likely to be

multiply determined. It is no wonder that there have been several terms to describe this phenomenon. We shall consider some of the most common terms and define the use of each term in our research.

Anosognosia, a term introduced by Babinski (1914), literally means a lack of knowledge of disease, but has through the years most often come to refer to a lack of awareness of hemiplegia (half-body paralysis) and hemianopia due to stroke. Some investigators refer to anosognosia broadly as a denial of illness (e.g. Heilman, 1991), but we shall use this term more selectively to describe unawareness of hemiplegia and hemianopia (Bisiach & Geminiani, 1991).

The term self-awareness is also commonly used in the literature and generally refers to the perception of changes in higher cognitive function (e.g. Bergquist & Jacket, 1993). Prigatano and Schacter (1991) define self-awareness as "the capacity to perceive the 'self' in relatively 'objective' terms while maintaining a sense of subjectivity" (p. 13).

A useful distinction to consider in this context is between awareness and knowledge. If awareness is taken to refer to the state or process of reflecting upon some fact of reality, knowledge can be seen as the stored representation of that awareness. Therefore, self-awareness is a state of reflecting upon one's self, and self-knowledge is the stored representation of that self-awareness.

Using a computer metaphor for the functioning of the nervous system, Johnson-Laird (1988) claims that a fundamental tenant of human consciousness is the ability to be self-aware, i.e., we have the ability to be aware of ourselves. In this scheme, self-awareness refers to awareness of the system that is cognizant. Johnson-Laird (1988) claims that the operating system must have a model of itself in order for the process of recursiveness, which underlies self-awareness, to occur. He claims that as humans we do not have full access to all of our self-descriptions; however, we do have access to many of our higher-level capabilities; the capacity to perceive, remember, reason, and act. Therefore, self-awareness is the conscious process of reflecting on one's own operating system or higher cognitive functions, which implies that we possess the capacity for some level of objective and subjective self-knowledge.

Self-awareness and self-knowledge are also differentiated in the temporal dimension. Awareness may be seen as a temporally limited process and self-knowledge as the temporally stable trait. The latter term is preferred because it implies a stable form of information about the self which can be assessed by comparison with some standard. Self-knowledge is usually measured by comparing the patient's ratings with either objective test performances, family ratings or staff ratings. Therefore, one of the concepts we shall use in the model is <u>comparative</u> self-knowledge of

deficits. This concept is similar to what (Crosson, Barco, Velozo, Bolesta, Cooper, Werts & Brobeck, 1989) refer to as intellectual awareness, which will be discussed later.

Denial has also been used to describe awareness disturbances, but historically it has been used in two different ways (McGlynn & Schacter, 1989). The first is neutral, similar to the broader use of anosognosia and unawareness. The second form is narrower and denotes the psychological defense mechanism of denial. This latter term refers to a patient that is aware of their deficits in some sense but is not psychologically able to confront them (whether intentional or not). The distinction is between patients that are unable to become aware of their deficits due to CNS dysfunction, as in the former, and reactive forms of unawareness in which the patient is theoretically able to be aware of the deficit (McGlynn & Schacter, 1989). From the previous discussion of awareness and denial, we can infer that the neurological inability to be aware and the reactive form of unawareness have a common effect; which is reduced self-awareness and self-knowledge. Because they have different etiologies, treatments, and long-term prognoses, Barco, Crosson, Bolesta, Werts & Stout (1991) make a similar distinction between impaired self-awareness due to psychological defense, which they called "denial," and neurologically mediated "awareness deficits." Consistent with Barco, et al. (1991), in the remainder of this paper denial

and awareness deficits shall refer to the reactive (psychological) and incapacity (neurological) mediated causes of impaired self-knowledge of deficits, respectively.

In sum, anosognosia shall refer specifically to unawareness of hemiplegia and hemianopia, and awareness of deficits refers to the ability to consciously reflect upon one's deficits. Self-awareness refers to the state of conscious perception of changes in higher cognitive function and self-knowledge to the stored knowledge which results from that awareness. Self-awareness and self-knowledge are thought to be affected by both the neurological inability to be aware and reactive forms of unawareness and are typically measured by a comparison to relatives, staff members or performance on tests. Neurologically mediated unawareness or the inability to be aware shall be referred to as an awareness deficit and reactive unawareness as denial.

What follows will be a brief review of the literature on psychological denial and awareness deficits, and theoretical models which attempt to account for them.

Psychological Denial

Denial is a reluctance to recognize deficits (either conscious or unconscious), based on psychological factors (Barco, et al. 1991). Psychological denial is understood to be a motivated defense mechanism which describes the individuals tendency to avoid or severely minimize some aspect

of reality which is perceived as threatening. While considered maladaptive and an obstacle to treatment by most, Lewis (1991) suggested that rather than being simply an obstacle to treatment, denial has adaptive value to the patient with brain injury. She goes on to say that "the patient is attempting to avoid awareness of some aspect of reality that would cause more pain than he or she can currently tolerate" (p. 235).

Denial may be due to reaction to illness, to pre-existing characterological disorders, or may be overlaid upon a neurological awareness deficit or may be due to any combination of the above (Crosson, 1987; Deaton, 1986; Prigatano, 1986a; Weinstein & Kahn, 1955). However, denial is not unique to head injury. Levine and Zigler (1975) found that stroke patients showed greater denial than patients with cancer or heart disease, which they suggested means that stroke represents a greater threat to the self. They concluded that denial was greater for stroke patients because the cognitive and emotional consequences of stroke are more devastating to the self than those resulting from cancer and heart disease. It is noteworthy to point out that they failed to consider the possibility that the "denial" which they observed in stroke patients was in fact due to CNS lesions (i.e. awareness deficits).

In their now famous monograph "Denial of Illness" Weinstein and Kahn (1955) studied the denial language of brain

impaired patients and concluded that the brain lesion does not cause impaired awareness. They claimed that the brain lesion " ...provides a milieu of function in which any incapacity or defect may be denied..." (p. 96). As shall be discussed later, this book was very influential in that it shifted interest to the psychological defense mechanism as cause of unawareness.

Denial may serve as a coping mechanism to reduce grief, increase self-esteem, avoid negative affect, and increase hope (Deaton, 1986). For example, Goldstein (1952) suggested that patients use denial to avoid an intense disorganizing anxiety reaction after a performance failure which he called a "catastrophic reaction."

Awareness Deficits

Following the publication of Weinstein and Kahn's (1955) book, neurologists were discouraged from investigation of denial, due to the belief that these deficits were topics of psychiatric study rather than neuropsychological syndromes. The effect was to emphasize psychodynamic defense mechanisms and premorbid personality characteristics. However, today emphasis has shifted toward understanding both the reactive and neurological aspects of unawareness of deficits (McGlynn, & Schacter, 1989).

An awareness deficit refers to the inability to recognize the deficits caused by impaired brain function (Crosson,

Barco, Velozo, Bolesta, Cooper, Werts & Brobeck, 1989). It is assumed that the cause is multifactorial. In order to be aware of deficits, the patient must be aware of several different types of functioning, i.e. they must demonstrate "self-awareness" for many different aspects of the self. For example, patients can be aware of their 1. sensory/motor (physical) functioning, 2. cognitive functioning (such as memory, attention, abstract reasoning, and language), 3. interpersonal and social functioning, and 4. emotional functioning. Unawareness in hemiplegia, visual disturbances, language disturbances, memory dysfunction, closed head injury, and premorbid levels of awareness are briefly reviewed.

Unawareness of hemiplegia. Altered awareness of deficits following brain injury was first observed by neurologists such as von Monakow, Anton, Pick, and Babinski during the late 19th century (Prigatano, 1991). Babinski (1914) coined the term anosognosia (literally, lack of knowledge of disease) to refer to lack of awareness of hemiplegia (half-body paralysis). Descriptions of such patients are striking; for example, patients will refuse to believe that a limb is their own despite repeated questioning and intact intellectual ability. Frequently, patients will admit their neurological symptoms but appear totally unconcerned, which is a related condition called anosodiaphoria (Heilman, Watson & Valenstein, 1985).

In the case of anosognosia for hemiparesis, Cutting (1978) observed that if properly questioned patients will

allow that they have some problem with the paretic limb but it was frequently phrased in terms of being "stiff" or "heavy." The preponderance of clinical evidence suggests that anosognosia for hemiplegia occurs during the acute stages of illness and the disturbance can be selective. Patients may deny weakness in the limb while retaining full awareness of the other deficits in language or visual functioning. For example, Wagner and Cushman (1994) interviewed 108 stroke patients and found that 40% of their sample had some degree of unawareness. However, unawareness was greatest for cognitive deficits (49% of sample), memory deficits (44%) and perceptual deficits (36%), and less common for hemiparesis (18%), affective/mood changes (16%), and speech deficits (4%).

Starkstein, Fedoroff, Price, Leiguarda, and Robinson (1993) investigated the neuropsychological deficits which anosognosic patients demonstrate. They administered a full neuropsychological battery (tests of frontal executive functioning, language ability, verbal and non-verbal memory, and attention) and an "anosognosia questionnaire" to 16 stroke patients. The anosognosia questionnaire primarily assessed anosognosia for hemiplegia and hemianopia. They found that anosognosic patients showed significantly lower scores on the Mini Mental Status Examination, verbal fluency (FAS), and Trails A and B compared to non-anosognosic patients. They concluded that anosognosic patients have significantly more

cognitive impairments, mainly on frontal lobe-related tasks, but not on memory tasks.

The bulk of evidence which has accrued since the late 19th century also suggests that neurologically mediated unawareness of hemiplegia varies as a function of lesion site (Cutting, 1978; Heilman, Watson & Valenstein, 1985; Lezak, 1983). McGlynn and Schacter's (1989) review of the literature on unawareness suggested that unawareness of hemiplegia is more common following large right posterior parietal and thalamic lesions. Cutting (1978) studied 100 patients with hemiplegia and found that 58% of those with right hemisphere dysfunction denied muscle weakness, compared to 14% of those with left hemisphere dysfunction. Wagner and Cushman (1994) found that the factors predictive of greater unawareness were lesion location and degree of global cognitive impairment. Those with cortical rather than subcortical lesions had greater unawareness and those with more global cognitive impairment had the greatest amount of unawareness. They failed to find overall right versus left hemisphere differences; however, they failed to include several left hemisphere cases because of severe aphasia. Hibbard et al., (1992) also found that despite high levels of unawareness of cognitive deficits, there were no differences between right and left hemisphere stroke patients. However, Wagner and Cushman (1994) did find greater unawareness of perceptual deficits for those with right posterior cortical lesions, and

many components of unawareness occurred with greater frequency when the lesions were anterior versus posterior, implicating right hemisphere and frontal regions. Starkstein, Fedoroff, Price, Leiguarda and Robinson (1992) found that patients with anosognosia for hemiplegia had a greater incidence of right temporoparietal, thalamic and basal ganglia lesions. Several other authors (Breier, Adair, Gold, Fennell, Gilmore & Heilman, 1995) also report greater anosognosia for hemiplegia following right hemisphere dysfunction (sodium amytol injection). Anderson and Tranel (1989) report that all of their stroke patients that had unawareness of hemiplegia had large right fronto-parietal lesions and dense hemiparesis. In addition, they report that these subjects also were unaware of cognitive deficits such as neglect of left hemispace, dysarthria, memory defects, and impaired nonverbal intellect. When they looked at the entire group of stroke patients (N=32), they found that 90% of the right hemisphere patients were unaware of at least one cognitive deficit, whereas only 41% of the left hemisphere subjects were unaware of at least one cognitive deficit.

The conclusions to be drawn from these studies suggest that anosognosia for hemiplegia characteristically develops following large injury to the nondominant hemisphere and is associated with cognitive impairments. The cortical component typically involves the postcentral association areas and the thalamus is a consistent subcortical correlate.

In their discussion of unawareness of hemiplegia, McGlynn and Schacter (1989) discuss the related phenomenon of neglect. Neglect is a specific neurological syndrome in which the patient fails to report, respond, or orient to novel stimuli in the opposite side of a brain lesion (Heilman, et al., 1985). Several authors include a discussion of neglect along with anosognosia for hemiplegia because they are both construed as forms of unilateral misrepresentation (Bisiach & Geminini, 1991). Neglect can be considered a form of unawareness (of the perceptual world) or inattention to the side of space contralateral to the lesion. Studies show they are frequently related. Heilman and Valenstein (1972) studied the relation between auditory neglect and anosognosia for hemiparesis in ten patients. Nine of the patients with auditory neglect had lesions in the right inferior parietal lobule and five of these patients also had anosognosia for their hemiplegia, demonstrating that similar lesions can lead to both conditions. Bisiach, Vallar, Perani, Papagano, and Berti (1986) also conclude that anosognosia is more common following right inferior posterior parietal lesions, similar to the site of lesions for neglect. In addition, Heir, Mondlock, and Caplan (1983) found that anosognosia was significantly correlated with neglect (r=.42). However, neglect can be seen independently from anosognosia for hemiplegia. For example, Bisiach et al. (1986) found that approximately one-third of their patients with anosognosia for

hemiplegia did not have unilateral neglect, demonstrating a dissociation between neglect and anosognosia for hemiplegia. Therefore, while neglect is dissociable from anosognosia for hemiplegia, it can be construed as a form of unawareness and there is a suggestion that it shares similar, but not completely overlapping, anatomic localization (Bisiach & Geminiani, 1991).

Unawareness of visual disturbances. As previously mentioned, patients may also deny visual disturbances that range from hemifield defects to bilateral cortical blindness (referred to as Anton's syndrome). Anton (1899; Cited in McGlynn & Schacter, 1989) was the first to provide a detailed description of denial of blindness in a 56-year-old woman who despite total blindness was unaware of her disability. Autopsy revealed bilateral lesions of the angular gyrus, occipital association cortex, and splenium of the corpus callosum. In several reported studies of Anton's syndrome there has been the suggestion that the disorder is associated with concomitant intellectual decline and disorientation (McGlynn & Schacter, 1989). They cite the Redlich and Dorsey (1945) study in which they reported that all six patients with unawareness of blindness had at least a moderate amount of intellectual decline and were generally disoriented, had impaired memory, and tended to confabulate. However, the exact role cognitive deficits have in maintaining the disorder has yet to be determined. Heilman (1991) proposed several

mechanisms to explain anosognosia for blindness. He suggested that a hypothetical monitor of visual input might be damaged or there may be false feedback to the monitor. This degraded input may reach the monitor from subcortical visual pathways.

Another form of unawareness for visual disturbances is that seen with hemifield defects. Bisiach et al. (1986) find that within a population of right brain damaged patients anosognosia for hemianopia is very common (88% of those with hemianopia denied visual disturbances) and is even more prevalent than anosognosia for hemiplegia. The exact mechanisms for this form of unawareness are also not well understood.

Unawareness of language disturbance. Unawareness of aphasic disturbances are most frequent following Wernicke's or jargon aphasia (Rubens & Garrett, 1991). Jargon aphasia is a form of language disturbance in which there is fluent output with neologistic or lexical jargon, with impaired comprehension, repetition, and naming. Because such patients have severe comprehension deficits and significant expressive deficits with fluent jargon, their unawareness usually cannot be detected verbally and has to be detected nonverbally. The first suggestion that they are unaware of their impaired speech output is the failure to make corrections in their speech or written productions. Other types of aphasic patients and non-aphasic people have been shown to make ongoing corrections in their speech output. The second reason

is that jargon aphasics often appear upset and frustrated with the "uncomprehending" examiner (Heilman, 1991). Unawareness of linguistic output is present when the speaker does not attempt to correct an error and, when confronted with that error, denies its occurrence (Rubens & Garrett, 1991).

Rubens and Garrett (1991) suggest that the reason that jargon aphasics are unaware of their errors may reflect either a general lack of awareness of the aphasia, a specific deficit in monitoring their speech, limitations in attentional capacity, or loss of a specific language structure (e.g. semantic, phonological, syntactic). They go on further to state that self-monitoring of communication functions primarily requires (a) attentional focus during production and (b) comprehension of output to assess whether the ongoing utterance conveys the intended meaning. This amounts to the conclusion that some patients fail to notice communication errors because they cannot speak and listen at the same time.

The anatomic localization of anosognosia for aphasia has shown the expected lesions to left posterior temporal regions (Wernicke's area). However, some studies suggest that bilateral lesions are necessary for full jargon aphasia and anosognosia for aphasia to develop (Rubens & Garrett, 1991; Weinstein, Lyerly, Cole & Ozer, 1966; cited in Mcglynn & Schacter, 1989). Weinstein et al. (1966) found that 14/18 jargon aphasics denied difficulty with speech while all 26 non-jargon aphasics did not have anosognosia for their speech

output deficits. In addition, among the jargon aphasics 14/18 had bilateral lesions. However, there are jargon aphasics with unilateral left hemisphere lesions that do not have anosognosia for their speech output deficits (Gainotti, 1972; cited in Rubens & Garrett, 1991). While more studies need to be conducted, the tentative conclusions to be drawn are that (a) most unawareness of aphasia is seen in jargon aphasia, (b) posterior left hemisphere lesions are necessary for jargon aphasia to develop and involvement of the non-dominant hemisphere is very common. (c) Unawareness of aphasia is common with bilateral lesions.

Unawareness of memory dysfunction. Memory disturbances can develop in a variety of neurological disorders (medial temporal lobe injury due to anoxia, epilepsy and temporal lobectomies, anterior communicating artery aneurysm, viral encephalitis, closed head injury, electroconvulsant therapy, and neoplasms) some of which can impair awareness of the memory deficit as well. It is reasonable and often suggested that, given the problems in recall that amnesics face, patients would be unaware of their deficits because they simply would be unable to recall their deficits. However, there are amnesic patients, particularly many with focal temporal lesions, that are aware of their deficits (Schacter, 1991) which suggests that the awareness deficit is not simply the result of failure to remember that one has a deficit. But while impaired memory may not be a sufficient condition for

unawareness, it may certainly contribute to unawareness (Schacter, 1990).

Korsakoff (1889; cited in Schacter, 1991), in his original discussion of the syndrome which bears his name, suggested that his patients were often unaware of their memory dysfunction. Korsakoff patients frequently have neuropsychological findings suggestive of frontal lobe impairment (Schacter, 1991). McGlynn and Schacter (1989) point out that impaired awareness of memory disorder has been described in other patients with signs of frontal impairment. Impaired awareness of memory dysfunction has been shown for patients with frontal tumors, ruptured anterior communicating artery aneurysm (ACoAA), and bilateral frontal damage secondary to head trauma. By contrast, patients with intact awareness of their memory impairment do not show frontal signs, such as patients with encephalitis affecting temporal lobe structures. In addition, Schacter (1991) reports that famous amnestic patients, with primarily non-frontal injuries, such as patient N.A. (localized lesion to the dorsomedial thalamic nucleus) and H.M. (bilateral temporal lobectomy) had normal awareness of deficits.

Unawareness of memory deficits may be due to poor monitoring of cognitive performance. This phenomenon is referred to as metacognition when referring to cognitive skills and metamemory when referring specifically to memory performance (Shimamura & Squire, 1986). Metacognition refers

to knowledge of ones own cognitive performance and is involved in problem solving. Metamemory includes both knowledge of one's memory strengths and weaknesses, and general knowledge of task and strategy variables that influence recall of information (Cooley & Stringer, 1991). Metamemory is a complex function which requires monitoring of memory performance, drawing inferences from this performance, storage of this information, and gaining access to this information when planning future behavior. One form of measurement is obtaining pre-performance predictions of cognitive performance (Cooley & Stringer, 1991).

Another method of assessing metamemory is the "feeling-of-knowing" paradigm. The most common feeling-of-knowing paradigm requires the subject to make judgements of expected recognition of previously non-recalled memory items. Shimamura and Squire (1986) investigated metamemory in amnesia patients with this method. They included three groups of patients: 1. Korsakoff patients, 2. ECT patients, and 3. a group of mixed etiology amnesic patients (anoxia, ischemia, patient N.A.). In the first part of the study, they asked patients general information questions and collected the first 24 items that each patient failed to get correct. Subjects were then given a chance to rate their chances of recognizing the correct answer if given choices. They rated how likely they were to recognize the answer on a 4 point scale (1-indicating high feeling of knowing, 2-medium feeling of

knowing, 3-low feeling of knowing, and 4-pure guess). Normal subjects typically show greater recognition accuracy for unrecalled items when they give high feeling-of-knowing ratings. The results showed that the Korsakoff patients had impaired feeling-of-knowing accuracy. The correlation between their predictions and recognition performance was lower than the corresponding correlation for control subjects and the other amnesia patients. In addition, the accuracy of the non-Korsakoff amnesia groups was not significantly different from the control group. Korsakoff patients demonstrated deficits in metamemory.

However, it was found that Korsakoff patients performed poorly on the general information test. Therefore, it may be that feeling-of-knowing accuracy in amnesic patients is only normal when recall performance is normal. For this reason, they examined feeling-of-knowing accuracy for newly learned information in a second experiment. Subjects were instructed to study sentences (e.g Mary has a garden full of marigolds.). Five minutes later amnesics were then given a sentence stem (Mary has a garden full of _____) to cue recall of the missing word (there was a 5 minute delay for amnesics and a 1-7 day delay for controls, before recall was attempted). They were then asked to give feeling-of-knowing ratings for the non-recalled items prior to the recognition trial. The non-Korsakoff patients had feeling-of-knowing predictions which were significantly correlated with recognition performance and

the magnitude of the correlation was similar to that obtained for the control subjects accuracy. Korsakoff patients feeling-of-knowing ratings were not correlated with recognition performance. These results suggest that Korsakoff patients have severe difficulty monitoring their memory performance while non-Korsakoff amnesia patients do not. This suggests that deficits in metamemory are dissociable from memory impairments in amnesics and indicates that Korsakoff patients are unaware of their memory deficits.

Schacter, McLachlan, Moscovitch, and Tulving (1986) studied the metamemory of three groups of memory impaired patients - those with closed head injuries, ruptured ACoAA's, and early Alzheimer's disease patients. Patients and controls were instructed to study lists of words. They were then instructed that they would be required to recall the list and to make predictions of how many of the 20 items from the list they would recall. As expected all three patient groups were significantly more impaired than controls in their free recall performance. However, the CHI and ACoAA groups were about as accurate as their control subjects in estimating their performance. The dementia group was very inaccurate in estimating their recall performance. This is consistent with the literature which suggests that Alzheimer's patients are unaware of their deficits and have extensive frontal lobe pathology later in the progression of the disorder (McGlynn & Schacter, 1989). An interesting aspect of this study is that

it serves as a counterexample to the observation that frontal lobe dysfunction leads to unawareness because the ACoAA and CHI patients, which both typically have some frontal lobe lesions, were found to be relatively aware of their memory functioning. However, this study does demonstrate that Alzheimer dementia patients have impaired metamemory.

Schacter (1991) suggests that head injury patient may show impaired awareness and metamemory if different methods of assessment are used. Sunderland, Harris, and Baddeley (1983) administered a questionnaire concerned with everyday memory functioning to a group of patients with severe head injury. They compared the patients reports with their actual memory functioning and found that their ratings were not associated with their performance on standard memory tests. In contrast, the family member ratings of the patients' memory were correlated with their actual memory performance, demonstrating that the head injury patients had impaired awareness of their memory disturbance. This study also suggests that the patients may have been unaware of their deficits because they were unable to recall instances of memory failure while filling out the questionnaire. Cooley and Stringer (1991) used a methodology similar to that used by Schacter, McLachlan, Moscovitch, and Tulving (1986) to study unawareness of memory impairment or metamemory in a sample of 23 mixed amnesic patients (TBI, dementia, tumor, strokes). Patients and outside observers predicted memory performance on various

standard memory tests. The authors designed the questionnaire to be isomorphic with standard memory tests (e.g. "how many items do you think you can recall from a 16 item list?" for 1st trial CVLT performance). Results showed that patient prediction of their own performance was less accurate than the outsiders predictions (friend or relative), suggesting impaired metamemory. However, the patients predictive accuracy was better than observed in the Sunderland et al (1983) study (note that the groups were different as well). This suggests that diagnosis of unawareness of memory impairment may depend, in part, upon the method of assessment.

Unawareness of memory disturbance may also be specific to a cognitive domain. Prevey, Delaney, and Mattson (1988) find that left temporal lobectomy patients tend to be inaccurate in estimating their verbal memory performance but are more accurate in estimating their spatial memory performance.

The Prevey et al. (1988) study also suggests that the memory impairment itself may be necessary for metamemory to be impaired. This is supported by a study by Stringer, Cooley, and Kertay (1988) in which they administered the Rivermead Behavioral Memory Test, a battery of everyday memory tasks, to 27 right hemisphere stroke patients. They also had patients estimate their performance on this task. The correlations between predictions and performance were poor. However, patients with poorer recall were least able to make accurate

judgements of their performance. This supports the idea that impaired memory is related to impaired metamemory.

In summary, clinical and experimental evidence (McGlynn, & Schacter, 1989; Schacter, 1991) suggests that most amnestic patients with unawareness of memory deficits have signs of frontal lobe pathology. For example, the Korsakoff patients have amnestic disturbances with well documented frontal lobe signs, a relative unawareness of their deficit, and impaired metamemory (Schacter, 1991). This suggests that deficits in awareness following memory disturbance may be due to frontal lobe dysfunction in many instances. Since the frontal lobes function to integrate information and monitor responses, it is not surprising that amnestic patients with frontal damage demonstrate an inability to be aware of their memory performance (Schacter, 1991).

Unawareness in closed head injury. There is abundant evidence that CHI patients are inaccurate in judging their cognitive and behavioral functioning. Given the varied neuropathology which can result from a closed head injury, patients often suffer from a variety of cognitive and sensory/motor deficits. As a result, CHI patients demonstrate unawareness for a variety of deficits.

As mentioned previously, regarding unawareness for memory disorders, Sunderland, Harris, and Baddeley (1983) found that severe CHI patient ratings of everyday memory performance was not associated with their performance on

standard memory tests, demonstrating impaired awareness of their memory disturbance. McGlynn and Schacter (1989) report on a study by Cockburn, Wilson, and Baddeley (1986) in which they investigated head injury patients' accuracy in estimating their memory functioning. They divided the patients into three groups based on their memory performance. The patient and a close relative rated their ability on a scale of everyday memory functioning. There was no correlation between self and relative ratings for the poor memory group, suggesting that poor memory may be related to unawareness of memory disorders. There was a low correlation between patient ratings of memory performance and objective performance in the moderate and poor memory groups. This provided further evidence for impaired awareness of memory disorders.

Rimel, Giordini, Barth, Boll, and Jane (1981) studied 429 mild head injury patients 3 months after their injury and found that 59% of the sample reported a change in their memory. However, family members indicated that the patient's memory was far worse than they had reported, which suggests that unawareness of memory impairment may occur even in cases of mild head injury. However, Miller and Stern (1965) commented on the notable lack of complaints that severe head injury patients have while "post-concussional" patients with only mild injuries frequently complain of their symptoms.

Providing more objective evidence of the differences between mild and severe head injury patient awareness of their

deficits, Allen and Ruff (1990) compared 28 mild-moderate head injury patients, 28 severe head injury patients and 31 normal controls ratings of their cognitive performance with their actual neuropsychological performance. Subjects were administered a questionnaire which assesses patients self-ratings of cognitive functioning in several cognitive domains (sensorimotor, attention, language, arithmetic, learning, memory and logical thinking). The severe and mild head injured groups both rated themselves as having "no problem" in the cognitive domains mentioned. The normal controls rated their different cognitive abilities as being "minor strengths." The results also showed that the neuropsychological performance of the severe group was significantly inferior to the mild group and normal controls. The mild head injury group's performance was not significantly different from normal controls' neuropsychological performance except for arithmetic. In order to compare ratings with performance, all scores were converted to z-scores utilizing a separate normative sample (N=180) that had also completed the rating scale and tests. When comparing the ratings with performance, the severe head injury group consistently overestimated their sensorimotor and attentional functioning. In contrast, the mild-moderate head injury group underestimated their performance. They were particularly pessimistic about their sensorimotor, language, and reasoning abilities. The test performance and self-ratings for the

normal controls was generally congruent except for overestimation of learning and logical thinking. These results demonstrate that severe head injury patients do not rate their cognitive functions in correspondence with test performance. While self-ratings did not differentiate the severe and mild-moderate groups, the severe group performed more poorly on neuropsychological tests. In addition, normal controls, while generally more realistic, are not so uniformly. This study also found that those with more chronic head injuries (greater than 1 year post trauma) tend to rate their cognitive performance as more impaired. This may suggest that awareness of deficits may increase with time (however, this finding may have limited generalizability to a group of severe head injury patients because both mild-moderate and severe head injury groups were combined for this analysis). In summary, this study states that those with severe head injuries tend to be unaware of their deficits. In contrast, the mild-moderate head injury patients tend to be more pessimistic and even hyper-aware of their deficits. It would appear that mild-moderate patients lose a relatively normal, positive bias when evaluating their cognitive functioning. While the severe group did not report their cognitive functions to be strengths, they still had an exaggerated positive bias. However, in order for them to be more realistic they would need to consider themselves as having some form of impairment, which they did not.

There have been advances in the use of questionnaires and interview formats to evaluate the level of unawareness in a head injury population. Anderson and Tranel (1989) conducted an "awareness interview", which assessed motor and cognitive functioning, with a group of head injury, stroke, and dementia patients and compared the responses with neuropsychologists' and neurologists' evaluations. They found that 68% of the head injury sample was unaware of cognitive deficits. Unawareness was most common for intellectual functions, memory, and speech and language. The neuropsychological variables which correlated with the level of unawareness were Verbal IQ and temporal disorientation. The investigators speculated that the deficits in VIQ and orientation are suggestive of "metacognitive" deficits which accompany unawareness of cognitive deficits. Utilizing a questionnaire format, Prigatano, Altman, and O'Brien (1990) compared family ratings with 64 head injury (mild, moderate, and severe head injuries) patients ratings on the Patient Competency Rating Scale (PCRS; a 30 item scale which asks patients, families or staff to make judgements about perceived competency to perform various daily activities; Roueche & Fordyce, 1983). The investigators chose 10 items from the PCRS for which they anticipated the most disagreement and 8 items for which they expected the most agreement between patient and family members. Their hypotheses were correct. The mean difference score for each of these sets of items were significantly

different. For the first set of items the patient ratings were consistently greater than the relative ratings. These items assessed complex cognitive activities, emotional control, and behavioral flexibility. The areas of competence in which the patients and relatives agreed, assessed basic activities of daily living (e.g. doing laundry, dressing self). In addition, seven neuropsychological measures were administered and correlated with the patient and the relative ratings on items of the PCRS. The correlations between ratings and neuropsychological tests revealed that many items from the PCRS were not related to any neuropsychological variables. However, the memory measures were generally related to either patient or relative ratings of memory ability and neuropsychological test scores had the greatest predictive power for relative's judgement of the patients' capacity to dress and prepare meals. Overall, this study showed that patients consistently underestimated problems in emotional control and social interaction, and the neuropsychological measures chosen for this study are not related to these particular behaviors. This study also demonstrated that patients and relatives have similar agreement concerning activities of daily living and neuropsychological measures were predictive of these behaviors. Prigatano (1991) reports on further analyses of the neuroradiographic and neuropsychological correlates of unawareness of these same 64 patients. Patients were divided

into 3 groups based on patient-relative discrepancies on the PCRS. Group I overestimated their competence, Group II had similar ratings to family, and Group III underestimated their competence. Group I patients showed decreased left hand motor speed but the other neuropsychological measures were not predictive of group membership. This suggests greater right than left hemisphere dysfunction but right hand motor speed was also below normal, suggesting bilateral injury. This was indirectly supported by radiographic analysis. Group I patients suffered significantly more lesions as visualized on MRI or CT scans. In addition, Group I patients also showed relatively more frontal and parietal lesions than the other groups.

Gasquoine (1992) investigated several methods of assessing awareness of sensory and cognitive changes and its relationship to emotional distress. Forty-two head injury patients completed three rating scales which asked questions about the effects of the injury on sensory and cognitive changes along with a measure of affective state. Therapists also rated the patients on their sensory and cognitive changes. Patients first reported changes in sensory and cognitive changes in a free report format. Patients provided a paucity of responses with this format; which could have been a result of the inability to generate responses. The majority of patients reported one or no problems. Patients then completed two rating scales with 10 questions about sensory

and cognitive functions (speed of performance, ability to plan, memory, hearing, ability to initiate, vision, ability to process information, learning, concentration, and word finding). They were given two formats, the first described the function and the second just used the name of the function (memory). The subjects were asked whether they had a problem with the function (awareness of change scale) and then asked whether the function was good, average or poor (awareness of deficit scale). The lack of a difference between abbreviated and complete behavioral descriptions demonstrated that there was no difference in rating between the two questionnaire methods of assessment but the patients reported significantly fewer deficits on the free report format than the questionnaire format. On the awareness of deficit scale, patients most frequently reported speed of performance and memory as being affected by the injury. When comparison was made with the therapists ratings, patients significantly underestimated the number of cognitive and sensory deficits and changes. Comparison between therapists and patients on the awareness of deficit scale revealed the highest agreement for the functions of concentration (38% agreement) and vision (36% agreement) and the lowest for initiation (23% agreement) and planning (14% agreement). On the awareness of change scale the highest agreement was found for vision (81% agreement) and hearing (73% agreement) and the lowest for learning (44% agreement) and ability to process information

(43% agreement). This study also found that the patients understanding of the meanings of cognitive and sensory terms was significantly correlated with the agreement between patients and therapists on the questionnaires. Poorly understood terms were the ones which showed the greatest discrepancies between patients and staff. This suggests that knowledge of the meaning of neuropsychological terms may be an important factor in understanding therapist-patient discrepancies, and the possible need for patient education. In addition, patients reported a high incidence of emotional dysphoria (depression, anxiety, and hostility) on the affective checklist. While none of the affective scales were correlated with length of post-traumatic amnesia, all of the affective scales were correlated with the awareness of change scores. This suggests that increased awareness of sensory and cognitive changes is paralleled by increased emotional dysphoria and decreased positive affect. Thus, the results of this study demonstrate that patients show the greatest unawareness for changes in initiation, planning, learning and the ability to process information, and the more they are aware of deficits or changes in these functions, the more likely they are to be emotionally distressed. In addition, two points are worth noting. This study showed that free report formats are likely to yield high estimates of unawareness (the most common method of assessment in the anosognosia literature), which may indicate that this is a

general problem with generating responses rather than a lack of intellectual awareness. This study also showed that if patients have a poor understanding of the meaning of neuropsychological terms this may lead to greater discrepancies between patient and staff ratings on questionnaires.

McKinley and Brooks (1984) compared 55 severe head injury patients (all had PTA greater than 48 hours) reports of deficits with reports from relatives. They assessed patients at 3, 6, and 12 months post-injury. They also investigated the relationship between cognitive performance and patient-relative discrepancies. The results showed that there was considerable agreement between relatives and patients regarding sensory deficits (loss of hearing 85% agreement, impaired sight 77% agreement), intermediate agreement for memory and concentration difficulty (65% and 63% agreement) and the least agreement for emotional and behavioral changes such as whether the patient had become bad tempered (60% agreement) or become more anxious (52% agreement). This agrees with reports in the literature which suggest that head injury patients are particularly reluctant to admit emotional/behavioral changes (Fahy et al., 1967). McKinley and Brooks (1984) also report that there were no significant correlations between awareness scores, calculated by taking a count of the number of problems the family reported which the patient did not report, and a number of psychometric tests

that assess verbal and non-verbal intelligence, verbal and visual recall, verbal fluency, and comprehension. This finding suggests that when patients deny a deficit which the relative states they have, this is not related to overall cognitive functioning, memory ability, and language ability. However, the authors question the usefulness of relative reports to assess awareness. They found that relative "neuroticism" was related to the amount of behavioral disturbance they report for the patients. This suggests that relatives that are more stressed will over-report difficulties, and the poor relationship between "insight" of the patients and the cognitive tests may be due to over-reporting of deficits by the family member. However, the relative which were more distressed may have been related to more severe patients. In addition, other studies show that when comparison is made between patients and staff, rather than family members, there is a negative correlation with the degree of neuropsychological impairment (Prigatano & Fordyce, 1986).

Fordyce and Roueche (1986) investigated the relationship between awareness of behavioral limitations, psychological distress, and response to treatment in head injury patients. They studied 28 patients with severe head injury at an average of 19 months post injury. They evaluated the patients level of awareness and psychological distress before and after 6 months of rehabilitation treatment. They discovered that

discrepancies between staff and patients on the PCRS predicted the degree of emotional distress as measured by the MMPI. They classified patients into three groups based on pre- and post-treatment patient/staff discrepancy scores on the PCRS. Group 1 initially had scores in line with staff and were significantly more distressed. However, as treatment continued distress decreased for this group. Group 2 and 3 patients initially overestimated their competency, and were significantly less distressed than the first group. Over the course of treatment group 2 subjects showed a trend for self ratings to approach staff ratings (i.e. greater awareness), while group 3 ratings did not change. In addition, group 3 patients tended to experience greater distress over the course of treatment (an interesting finding given their disagreement with staff about their behavioral functioning). These results demonstrate that prior to treatment intact awareness is related to greater emotional turmoil. Results also showed that group 3 patients had poorer neuropsychological functioning and they showed a trend toward poorer vocational outcome. In addition to staff ratings they obtained ratings from a patient family member. The results show that ratings of competence were highest for the patient, followed by the family and the lowest ratings were from the staff, suggesting that the level of awareness (or level of comparative self-knowledge) depends on the comparison standard utilized (i.e. family-patient vs. staff-patient). Other conclusions to be

drawn from this study are (a) awareness varies in a head injury population, (b) prior to treatment greater awareness is related to more emotional distress, (c) not all patients respond to treatment interventions (among those beginning treatment with impaired awareness and low psychological distress) (d) unaware treatment non-responders have greater initial neuropsychological deficits and greater emotional distress at the end of treatment, and (e) impaired awareness (comparative self knowledge) has consequences for vocational outcome.

Ranseen and Bohaska (1987; reported by McGlynn and Schacter, 1989) extended Fordyce and Roueche (1986) findings by investigating the relationship between staff and patient ratings on the PCRS and location of lesions following TBI. Awareness of behavioral competence was examined in 32 patients with focal right, focal left, or diffuse damage before and one month into rehabilitation. Patients were found to consistently over-rate their competencies at both test intervals. Focal right sided injured patients showed greater staff-patient discrepancies than focal left hemisphere injured patients at both test intervals.

As the previous studies demonstrated there are patients that continue to have awareness deficits for some time following the injury. Groswasser, Mendelson, Stern, Schechter, and Najenson (1977; reported in McGlynn and Schacter, 1989) report that all patients that exhibited

unawareness of behavioral disturbances at 6 months continued to be unaware at 30 months. Fahy, Irving, and Millac (1967) conducted a 6 year follow up of 32 severe head injury patients (6 had died and they report findings for the remaining 26). They found that the patients rarely spontaneously complained of any difficulties. However, more thorough interview with the patient and family revealed that while they are aware of deficits in intellect, memory, and speech, they seldom acknowledged temperamental difficulties, which caused much distress in the family members. They reported that nearly 70% of their sample had some form of psychiatric symptoms. This study suggests that many severe head injury patients remain unaware of behavioral and emotional symptoms several years following their injuries.

There are several general conclusions to be drawn from these studies of CHI. (a) Unawareness appears to be common for severely head injured patients and may continue several years following the injury. (b) Unawareness is typically assessed by comparison of the patients perceptions with either actual performance on tests, relative perceptions, or staff member perceptions. (c) While severe head injury patients tend to be unaware of a variety of deficits, unawareness of emotional, cognitive and social functioning are particularly common findings. (d) More awareness tends to be correlated to increased emotional distress. In the studies reported here, the ability of neuropsychological measures to predict

unawareness has been mixed. This is likely due to the choice of tests, and as Prigatano, Altman, and O'Brien (1990) suggest, the typical neuropsychological measures used do not capture the higher order behavioral capacities of individuals which underlie the unawareness phenomenon.

Premorbid levels of awareness A discussion of awareness of deficits following brain injury would not be complete without mention of premorbid levels of awareness. Prior to the illness certain cognitive functions may vary in the level of awareness which is displayed for their operation. In their discussion of the mechanisms responsible for unawareness, Goldberg and Barr (1991) support the idea of variability in awareness of certain cognitive functions which is based upon a basic philosophy of linguistic determinism. They claim that the greater incidence of unawareness following right hemisphere injury may in part be due to decreased awareness of their operations prior to the injury. Linguistic determinism states that the content of intrapsychic processes typically gets linked with symbolic systems (language being the best example). Specifically, the internal experience of the external world is organized by symbolic components of language. The left (or dominant) hemisphere predominantly mediates well developed representational systems and therefore, mediates consciousness and self-awareness. They point out that the selectivity in unawareness postmorbidly may be due to factors which predate the illness. They base this

conclusion on the assumption that even in neurologically intact individuals certain cognitive functions are characterized by greater awareness than others (we are typically less aware of many right hemisphere functions relative to many left hemisphere functions). Stated differently, normal cognition is characterized by varying degrees of awareness of the operational content of cognition. The implication is that the patient may be unaware of a cognitive function because even premorbidly the internal representation of the intact cognitive function was "fuzzy" (Goldberg & Barr, 1991).

In addition to variability in awareness of different cognitive functions, individuals may also vary in their premorbid level of awareness of their cognitive functions. This basic conclusion is supported by Weinstein and Kahn (1955) in their famous monograph "denial of illness." Prigatano and Leathem (1993) compared the awareness of behavioral limitations that TBI of different cultural groups demonstrate. They found that TBI patients from different cultural groups, but matched demographically (the Maoris and Non-Maoris of New Zealand), report different levels of behavioral competency. This suggests that cultural variables influence perceptions that TBI patients have of their behavioral limitations and by implication suggests that premorbid variables influence post-morbid awareness in TBI.

In summary, the ability to consciously reflect on one's deficits results in self-knowledge of deficits, which is measured by discrepancies between patients' ratings and staff ratings, relatives' ratings, or performance. Comparative self-knowledge may be impaired by motivated processes such as denial, or neurologically mediated processes such as awareness deficits. In addition, consideration must be also given to premorbid levels of awareness. There is abundant evidence to suggest that impaired self-knowledge of deficits is a ubiquitous phenomenon following CHI, which has drastic consequences for patient adjustment to society, and functions as a protection from psychological distress.

As can be gleaned from this brief review, the phenomenon of unawareness is diverse. It can occur for a variety of reasons, and there is reason to believe that premorbid awareness is selective. A consistent theme in the preceding review is the distinction between unawareness for higher order perceptual and cognitive deficits (e.g. aphasia, amnesia, behavioral limitations, emotional and social functioning) and unawareness restricted to one hemispace or hemifield (anosognosia for hemiplegia, hemianopia).

Awareness Deficits Theories

There are several neuropsychological theories which attempt to account for the inability to reflect upon one's deficits. Some of the theories attempt to account only for a

selective form of unawareness, while others attempt to develop models which account for all the phenomenon from this diverse field of investigation. Emphasis shall be given to those theories which are most relevant to the unawareness typically observed in CHI patients. Some have claimed that awareness deficits can be the result of impaired attention/arousal (Heilman, Watson & Valenstein, 1985; Rubens & Garrett, 1991), memory (Schacter, 1991), frontal executive self-monitoring (Lezak, 1983; Stuss & Benson, 1986), or modality specific monitoring deficits (Prigatano, 1991; Bisiach, Vallar, Perani, Papagno & Berti, 1986; Bisiach & Geminiani, 1991; Heilman, 1991; Schacter, 1990). In addition, there are theories which explain how awareness deficits are expressed. Each of these theories shall be reviewed.

Attention. Studies demonstrate that CHI patients experience attention/concentration deficits several years following the trauma (Sohlberg & Mateer, 1989), and these deficits have dramatic consequences for patient adjustment. Prigatano and Fordyce (1986) review studies which suggest that severity of CHI is related to the degree of attention deficit. The inability to apprehend and hold information in conscious awareness (i.e. attention deficits) creates one of the greatest impairments for CHI patients (Gronwall, 1989; Sohlberg & Mateer, 1989). However, investigation is difficult because a single unifying theory of attention has

not generally received wide acceptance (Sohlberg & Mateer, 1989).

Posner and Rafal (1987) differentiate three forms of attention which are hierarchically arranged: arousal, selective attention, and vigilance. The first form of attention is basic alertness and arousal, which they divide into tonic and phasic arousal. Tonic alertness refers to diurnal fluctuation and phasic arousal is the instantaneous facilitation of performance induced by a warning signal. The second form of attention requires the selection of specific environmental or internal stimuli for further conscious processing. Hemispatial neglect can be seen as one type of deficit in selective attention. The third form of attention is sustained concentration or vigilance. Vigilance refers to the maintenance of conscious mental effort across some period of time.

Sohlberg and Mateer (1989) reviewed the literature on attention deficits following head injury and devised a model which extends the forms of attention posited by Posner and Rafal (1987). Their model accounts for the classic view of attention as an information processing capacity as well as incorporating the working memory component of attention (Baddeley, 1981). They consider attention to be a multidimensional capacity which is critical to memory and other forms of cognition. They present five levels of attention which are hierarchically arranged; focused,

sustained, selective, alternating, and divided attention. It is presumed that deficits in successively lower elements of attention will result in failure in higher forms. For example, a deficit in focused attention will create difficulties maintaining selective and divided attention.

While impaired recognition of attention deficits has been reported (Allen & Ruff, 1990), few studies speculate directly on how attention deficits contribute to unawareness. Some investigators have suggested that attention serves the general function of maintaining awareness (Buchtel, 1987). Heilman, Watson, and Valenstein (1985) suggest that impaired arousal/attention may be the cause of some unawareness phenomena (anosognosia for hemiplegia). Allen and Ruff (1990) consider the ability to attend essential to a definition of awareness. They define awareness as the ability to attend, encode, and retrieve information concerning the self. Rubens and Garrett (1991) suggest that a possible mechanism of unawareness in language disturbances may be due to impaired focused attention of their speech output.

McGlynn and Schacter (1989) suggest that among head injury patients poor attentional abilities may contribute to unawareness. Evidence that attention is related to unawareness among head injury patients is supported by a study by Bergquist and Malec (1993). They administered the Patient Competency Rating Scale (PCRS); which is comprised of items related to activities of daily living, emotional functioning,

and interpersonal skills, to 40 patients with severe traumatic brain injury and their staff in order to obtain the discrepancy which was used as a measure of awareness. When they divided the patients into three groups based on severity of unawareness they found poor attentional functioning (as measured by the Freedom from Distractibility Factor from the WAIS-R) for the groups that showed the greatest unawareness.

Following CHI, deficits in the higher forms of attention such as alternating and divided attention, are particularly impaired, resulting in significant impairment in daily life (Sohlberg & Mateer, 1989). These studies and reviews suggest that adequate attentional capacity at all levels, from focused to divided attention, provides the foundation for memory and cognitive processing; thus, deficits in attention should contribute to awareness deficits. Therefore, assessment of the higher forms of attention, particularly the alternating and working memory components of attention, would assess both higher and lower forms of attention deficits.

Memory and metamemory disturbance. In addition to problems attending, CHI patients have difficulty recalling recent events and acquiring new information. Baddeley, Harris, Sunderland, Watts, and Watson (1987) suggest that the structure of memory is divided into three parts. The first is a brief sensory memory which includes iconic (visual) and echoic (auditory) memory. The second, previously referred to as short-term memory, is currently referred to as working

memory. However, Cowan (1988) conceptualizes working memory as a subset of short-term memory (a scheme which we will adopt for the current study). Working memory refers to the temporary activation, storage, and manipulation of information necessary for understanding, reasoning and learning. It assumes a central executive system which coordinates several other subsidiary systems. The third component is long-term memory, which implies the long-term storage of information. Distinctions have been suggested for long-term memory, such as semantic versus episodic, procedural versus declarative, and prospective memory (Baddeley et al., 1987).

CHI can result in difficulty recalling preinjury events or retrograde amnesia, and difficulty acquiring new information or anterograde amnesia (Baddeley et al., 1987). Posttraumatic amnesia refers to the early stage of confusion and disorientation following trauma in which new memories are not formed and can be considered a subtype of anterograde amnesia.

Evidence suggests that impaired anterograde memory may contribute to unawareness, but by itself does not preclude adequate self-knowledge from developing (Schacter, 1991). Some have suggested that unawareness of deficits may be due to poor monitoring of cognitive performance. This phenomenon is referred to as metacognition when referring to cognitive skills and metamemory when referring specifically to memory performance (Shimamura & Squire, 1986). Metacognition refers

to knowledge of one's own cognitive performance and is involved in various aspects of problem solving such as consideration of the cognitive operations required to solve a particular problem. Metamemory includes both knowledge of one's memory strengths and weaknesses, and general knowledge of task and strategy variables that influence recall of information (Cooley & Stringer, 1991). Metamemory is a complex function which requires monitoring of memory performance, drawing inferences from this performance, storage of this information, and gaining access to this information when planning future behavior. In the literature reviewed previously, metamemory procedures such as the feeling-of-knowing paradigms are considered to be experimental indices of unawareness of memory impairments and in some cases have been used synonymously.

As stated in the previous section on unawareness of memory impairment, clinical and experimental evidence (McGlynn & Schacter, 1989; Schacter, 1991) suggests that amnestic patients with unawareness of memory deficits have signs of frontal lobe pathology and metamemory disturbances. For example, the Korsakoff patients have amnestic disturbances with well documented frontal lobe signs, a relative unawareness of their deficit (Schacter, 1991), and disturbances in metamemory (Shimamura & Squire, 1986). These findings suggest that unawareness of memory disturbance and impaired metamemory may be due to frontal lobe dysfunction.

Schacter (1991) suggests that since the frontal lobes function to integrate information and monitor responses (Stuss and Benson, 1986), it is not surprising that amnestics with frontal damage demonstrate an inability to be aware of their memory performance. It is this "on-line" monitoring that frontal patients lack, which leads to unawareness. When this mechanism is intact it allows awareness which frequently leads to distress about the deficit (Schacter, 1991). The other frontal mechanism that may be responsible for unawareness of memory impairments is the frequent problem frontal lobe patients have inhibiting strong response tendencies. So when a frontal patient is asked about their memory impairment the strongest response tendency may be to report on "premorbid" memory function (Schacter, 1991).

In summary, studies suggest that impaired monitoring of memory performance (i.e. metamemory) is a necessary element for unawareness of memory disturbances and impaired memory sustains unawareness (Schacter, 1991). Metamemory disturbances are common for head injury patients and these deficits are related to frontal executive functioning.

Frontal executive functioning. The frontal lobes are thought to subserve many of the complex integrative functions of cognition (Stuss & Benson, 1986). As previously mentioned, frontal functions are involved in attention and memory contributions to impaired awareness. Also previously mentioned, the frontal lobes are frequently damaged following

CHI. Descriptions of frontal lobe unconcern and unawareness of deficits are also well documented (Stuss, 1991).

Stuss and Benson (1986) developed a framework for understanding the specialized functions of the frontal lobes. They hypothesized that there are three major areas of frontal function. They postulated that the brain consists of a number of organized integrated functional systems; sensory-motor, emotion, memory, and language (Stuss, 1987; Stuss, & Benson, 1986). Each system has direct and reciprocal connections to the frontal cortex. Posterior-basal brain areas are thought to mediate the various functional systems, thus damage to frontal areas frequently leaves overlearned abilities and overall intellect intact. This frequent finding correlates with clinical evidence which suggests that frontal patients can have intact IQ, but when tasks require the patient to structure responses, performance deteriorates (e.g. Wisconsin Card Sorting Test; Stuss, 1987). The first set of functions combines two anterior functional systems: sequencing and drive. Sequencing is dependent on intact lateral (dorsal and orbital) frontal structures, and drive mediated by the medial frontal structures. Sequencing organizes bits of information in meaningful sequences, and drive initiates action (pathology results in either decreased and apathetic or excessive and impulsive behavior).

The second function of the frontal lobes is their executive or control abilities. In routine environments the

posterior system functions adequately; however, with novelty, the frontal executive is active. The executive system extracts information from posterior regions, anticipates, plans, selects, experiments, and modifies as the demands require. These functions are thought to be particularly prefrontal, and often dysfunctional following CHI (Lezak, 1987b). Lezak (1987b) suggests that executive function is defined by goal-directed behavior, i.e. the ability to formulate goals, plan and organize behavior relevant to those goals, monitor performance, and self-correct behavior to bring it into line with the original goal.

The third, related function of the frontal lobes, particularly prefrontal regions, is introspection, self-awareness, and self-consciousness. Lezak (1987b) identifies this as taking the "abstract" attitude, i.e. taking a perspective different from one's own. In the case of self-awareness it means taking one's self as the object of study. Damaged frontal lobes frequently leave patients with very shallow interests, and loss of self-concern. The lack of self-awareness is likened to disturbed metacognition (i.e. the inability to think about one's thinking). Self-awareness is necessary for the correction of a present state with a mental comparison (Stuss & Benson, 1986). Stuss (1991) maintains that this frontal system unawareness is not a lack of knowledge; it is instead impaired judgement of the facts in relation to one's own life. In behavioral terms, self-

awareness deficits are revealed in unconcern, impaired self-monitoring, and deficient self-regulation. Impaired self-awareness leads to deficits in alteration of behavior and belief system. Lezak (1987b) identifies the later two functions of executive control and introspection as essential requirements of successful vocational re-entry.

In sum, Stuss and Benson (1986) and Lezak (1987b) are suggesting that the frontal lobes are directly involved in self-awareness and monitoring of cognition and behavior. Therefore, awareness deficits resulting from frontal pathology could be viewed as a self-monitoring and self-awareness deficit.

Modality specific/Modular models. Bisiach and Geminiani (1991) propose a modality-specific model to explain unilateral representational disorders such as anosognosia for hemiplegia and hemianopia, neglect, and somatoparaphrenia. In their model, they suggest that consciousness is at least partially composed of modality specific representations which are parallel, spatially distributed, and sensory specific.

A more encompassing modality-specific or modular model is presented by Prigatano (1991) in which the "type" of unawareness observed varies as a function of the particular heteromodal cortex which is lesioned. Heteromodal cortex, previously termed tertiary cortex by Luria, responds to multiple modalities of stimulus input, and therefore, subserves the highest functional organization of the various

inputs to that cortical region. Thus, unawareness of body image may result from inferior parietal lobe damage; impaired awareness of linguistic output dependent upon intact superior marginal, angular, and temporal gyri; and higher level unawareness of social judgment, resulting from damage to prefrontal regions. This model implies that awareness of a particular function is served by the same cortical region which represents that function. He suggests that this may be why CHI frequently impairs many higher cognitive functions along with deficits in awareness of those functions.

Schacter (1990) makes the similar claim that site of lesion determines the particular form of unawareness and deficit. He attempted to explain unawareness of deficits following brain injury by postulating a phenomenal awareness system named the Dissociative Interaction and Conscious Experience (DICE) model. In his model he suggests that there are specific knowledge modules, such as lexical, conceptual, facial, and self, which normally contain specific overlearned information. These knowledge modules normally have reciprocal connections with a higher level processing system, or Conscious Awareness System (CAS). Should one of these connections dysfunction, deficits in awareness of that specific module would be impaired, similar to Prigatano's model. However, if damage occurred to the CAS, awareness would be impaired across multiple domains. Damage to specific modules can result in unawareness for that specific function,

and it is likely that the function impaired will vary according to the site of lesion. Schacter (1990) also suggests that the anatomical correlate to the CAS is a posterior system involving the inferior parietal lobule. The inferior parietal region is where visual, somesthetic and auditory pathways converge.

The DICE model also posits that the CAS has connections to a frontal "executive system" which initiates, organizes, and modulates complex ideas and behaviors. This is consistent with Stuss and Benson's (1986) conceptualization of executive functioning. Studies show that there are reciprocal afferent connections between the frontal lobe and the inferior parietal lobe (McGlynn & Schacter, 1989). The DICE model suggests that the CAS mediates awareness of relatively simple perceptual and motor responses, and the executive system is responsible for awareness of complex functions. Thus, damage to the parietal lobes should result in classic unawareness of hemiplegia and hemianopia, etc., while damage to the frontal lobes will result in unawareness of complex deficits, such as problem solving, social, behavioral and personality changes. For example, Anderson and Tranel (1989) provide evidence which suggests that unawareness of motor impairments is dissociable from unawareness of cognitive deficits, consistent with Schacter's (1990) formulations. In addition, the Wagner and Cushman (1994) study confirms some of the anatomic localization predictions of the DICE model. They found that

unawareness of perceptual deficits were more common following right posterior cortical lesions and unawareness for complex deficits (reason for hospitalization, cognitive deficits, and memory deficits) were more common following anterior lesions.

With the intact brain, our sensations and perceptions have contact with our thoughts, past experiences, and feelings. Our brain allows us to evaluate ourselves and the world around us, decide what is right, and take appropriate action when necessary. However, self-evaluation and behavioral initiation may be particularly impaired following CHI. As Schacter (1990) and Prigatano's (1991) theories suggested, awareness deficits may exist for relatively lower order sensory-motor deficits, or higher cognitive-emotional functions (Anderson & Tranel, 1989; McGlynn & Schacter, 1989). The latter form of unawareness has come to be termed a deficit in self-awareness. Stuss and Benson (1986) also suggest that self-awareness deficits are distinct from simple unawareness of deficit, such as for hemiplegia or hemianopia. Despite these endorsements the term is not without confusion, because deficits in awareness of motor behavior are still related to the self and constitute impaired "self-awareness." In spite of this confusion, the distinction between awareness of motor and higher cognitive dysfunction appears to have functional and anatomical significance. The importance of these modality specific and modular models is their ability to encompass many unawareness phenomena, integrate such phenomena with knowledge

of anatomy, and therefore, serve as rich sources of theory based research.

Levels of awareness model. Another integrated model of awareness deficits was developed by Crosson, Barco, Velozo, Bolesta, Cooper, Werts & Brobeck, (1989). They find that head injury patients demonstrate different types of awareness deficits which are interdependent and hierarchically arranged. The model they developed helps to explain why patients may report deficits while not demonstrating this awareness in their behavior i.e why awareness deficits may lead to functional impairments, even when a patient can verbally report a particular deficit. These forms of awareness help elucidate how patients become unaware of their deficits while possibly suggesting mechanisms which underlie these functions.

The first type of awareness is intellectual awareness, which is defined as the ability to understand that a particular function is impaired. This type of awareness is fundamental for more "on-line" forms of awareness. Knowledge of impairments represent anterograde information, thus intellectual awareness may be impaired by many of the mechanisms reviewed such as problems obtaining information caused by abstract reasoning, memory, or metamemory disturbances (Shimamura & Squire, 1986).

The second level of awareness is emergent awareness, which is the ability to recognize a problem while it is occurring. This requires intellectual awareness. It also

requires monitoring the relationship between their actions, the effect they are having on the environment, and the desired cognitive or behavioral product. This on-line form of awareness is described by Goldberg and Barr (1991) as a process of error monitoring. They posit three mechanisms of error monitoring which underlie an awareness of deficits. The first is an internal representation of the desired cognitive process or behavior, the second is the feedback of the actual output, and the third is an intact mechanism which compares the actual output with internal representations of the desired cognitive and behavioral product. This latter mechanism is similar to working memory, i.e. the temporary activation, storage, and manipulation of information necessary for understanding, reasoning, and learning. Working memory implies a central executive which coordinates the manipulation of information. The central executive's function is similar to that of a CPU in a computer, selecting information to be stored in RAM while comparing information obtained from memory storage. The central executive is needed in order to select information to be retrieved into working memory.

While performing a behavior which is being affected by their deficits, patients must first receive feedback regarding their actions, then compare their current behavior and the desired cognitive or behavioral product. In addition, it requires that they access the stored knowledge of the deficit in long term memory and make a decision regarding whether such

behavior is related to the deficit, i.e. if it fits some exemplar of the "deficit" or behavior that would result from the deficit.

Barco, Crosson, Bolesta, and Stout (1991) present a case study which illustrates the following form of awareness. The client was a well educated woman in her 20's who had sustained a severe closed head injury in a motor vehicle accident. MRI revealed bilateral contusion to frontal and temporal lobes, as well as contusion to the left posterior internal capsule. Five months post-injury she was found to have difficulty with verbal memory, moderate language problems, and lapses of attention. Exacerbating her deficits was a lack of awareness of the existence of these problems, i.e. a deficit in intellectual awareness. Her attention deficits were assessed to be one of the greatest impediments to her functional recovery. For example, during an occupational therapy assessment which required her to follow a simple route, she distracted herself with her own conversation to such an extent that she did not attain her goal. When these errors were pointed out to her she made "excuses." With constant feedback during 3-4 weeks of therapy she was able to gain a greater level of intellectual awareness about her deficits. However, she was unable to utilize this information during a task. This represented a lack of emergent awareness. For example, during a study skills trial, she had great difficulty attending to the task, and she did not recognize the

difficulty as it was occurring. Although she had the knowledge that she had a problem with attention and being distracted, she failed to utilize it "on-line" which made the knowledge of her deficits useless in that particular situation. In terms of error monitoring as presented by Goldberg and Barr (1991), the "desired behavior" was that she attend to her studies. Since previous evaluation suggested that she developed intellectual awareness, i.e. she knew the "desired behavior", this suggested that she either lacked feedback regarding her behavior, or the mechanism which compares the desired product was dysfunctional. Through further training she was able to learn to recognize when she was getting inattentive, thus increasing her emergent awareness. However, therapy was unsuccessful at improving her ability to anticipate when and where she might be more vulnerable to experiencing attention difficulties.

This last form of awareness that the patient lacked is anticipatory awareness, i.e. the ability to anticipate that a problem will occur due to the deficit. This is the most complex form of awareness and is dependent upon the other two forms of awareness. Anticipatory awareness may be needed even when completing a rating scale. For example, in order for patients to rate their competence performing several of the behaviors listed on the PCRS, patients must have either had experience with the behavior or been told that their deficits will cause difficulty performing these behaviors. Otherwise

patients are required to use anticipatory awareness to evaluate their competence. In other words, patients must have intellectual awareness to complete the PCRS, while feeling-of-knowing paradigms require anticipatory awareness, specifically for memory. The ability to anticipate that a problem will occur as a result of a deficit also requires adequate abstract reasoning ability.

In summary, intellectual awareness, emergent awareness, and anticipatory awareness are hierarchically dependent levels of awareness. Some of the neuropsychological mechanisms necessary for their functioning may be adequate memory, metamemory, executive and error monitoring, working memory, and abstract reasoning.

Summary

Several themes emerge from the above review of awareness of deficits:

1. Awareness deficits are common, particularly for severe closed head injury patients.

2. Awareness deficits can occur because a variety of underlying deficits.

3. Decreased awareness has consequences for rehabilitation, vocational and occupational adjustment.

4. The review also supports several distinctions: (a) the literature suggests that unawareness can be due to an incapacity to be aware (awareness deficit) or the result of a

defensive reaction to deficits (denial). (b) Self-awareness is a state of reflection on one's self while self-knowledge is the stored representation of this knowledge. (c) The level of self-awareness and self-knowledge is usually assessed by comparison with some "objective" standard. (d) A common distinction is between awareness of relatively simple functions versus awareness of higher level functions.

5. Awareness deficits vary as a function of lesion site. The frontal and parietal lobes have been implicated most often, and the right hemisphere appears to play a special role in mediating awareness.

6. The more patients become aware of their deficits the more psychological distress they experience.

7. Patients may have been unaware of certain cognitive functions premorbidly, which impacts awareness after injury.

8. Theories that have been presented suggest various neuropsychological mechanisms to explain awareness deficits. The theories suggest that awareness deficits may be caused by impairments in attention, memory, metamemory, working memory, frontal executive self-monitoring, and abstract reasoning. Frontal functioning figures prominently in many of these theories and they suggest that one of the functions of the frontal system is to mediate self-awareness.

9. Denial is thought to be an important cause of unawareness.

Self-Concept After Closed Head Injury

While CHI frequently results in impairments of cognition, physical functioning, social functioning, and self-knowledge, patients continue to have conceptions about themselves. Patient evaluation of their status has significant consequences for their adaptation and emotional well being. For example, Lewis and Rosenberg (1990) suggest that low self-esteem and anxiety are the most common themes in psychotherapy with CHI patients. In addition, recent evidence suggests that CHI patients' self-reports and self-evaluation of their status is an important area for study and provides a needed adjunct to neurobehavioral testing (Allen & Ruff, 1990; Fordyce & Roueche, 1986; Tyerman & Humphrey, 1984). The purpose of the current section is to describe the structure and function of the self-concept in CHI.

Only a handful of investigators have measured self-concept and self-esteem with CHI patients (Lynch, 1989; Newton & Johnson, 1985; Thomas, 1990; Tyerman & Humphrey, 1984), despite the general agreement that self-esteem functions as a protection against psychological distress (Bednar, Wells, & Peterson, 1989; Rosenberg, 1989), and despite the negative relationship between self-esteem and psychological distress in other populations (Harter, 1983; Horney, 1937; Robson, 1988; Rogers, 1961; Rosenberg, 1989). Lewis and Rosenberg (1990) suggest that self-esteem is lower in those with head injury and " .....frequently a patient's low self-esteem and lack of

motivation result from the psychological impact of the trauma and it's sequelae."

Lynch (1989) evaluated the global self-esteem (using the Rosenberg Self-Esteem Scale), self-consistency, and self-consciousness of 40 mild head injury patients several months after their expected neuropsychological recovery. She found that the patients had moderate to high levels of self-esteem; however, she did not make statistical comparison to a control group. In addition, their self-concept was stable, i.e. they did not demonstrate low scores on a measure of self-consistency. She also found that patients had mild neuropsychological deficits on attentional and memory tests (e.g. the PASAT, and CVLT), and their self-concept was moderately related to neuropsychological outcome. They found that decreased cognitive deficits were associated with high self-esteem, high self-consistency, and low self-consciousness.

One of the only studies designed to evaluate the self-concept in a severe head injury population was done by Tyerman and Humphrey (1984). They had 25 severe CHI patients, seven months post-injury, rate the following; the semantic differential (a measure of self-concept), measures psychological distress, and measures of physical disability. On the semantic differential subjects made judgements of their present, past, and future self, as well as for the typical person and for the typical head injury patient. They found

that CHI patients have drastic changes in their self-concept while expecting to return to premorbid levels in a short time. Their ratings for present self were significantly below both the ratings for past self and future self. The ratings for past self and future self were nearly identical. This suggests that their self-concept had declined but was expected to return to normal, premorbid levels. When rating the same scale for a typical person and typical head injury patient the results showed that patients believed that there were no differences between their present self-concept and that of a typical person. However, they did believe that they were better off than the typical head injury patient. They reported themselves to be more interesting, in control, mindful, active, and cooperative. They also believed that the typical head injury patient has lower self-concept than the typical person.

Tyerman and Humphrey (1984) also evaluated the relationship between physical deficits and the physical self-concept. They administered the Litman Physical Disability Self-Conception scale and found that with regard to their social discomfort, and self-image of their physical disability, many patients (30-40%) had a reduced sense of personal worth and were self-conscious about their physical disabilities. This suggests that CHI patients have a physical self-concept which is affected following the physical injuries they receive. In addition, they found that patients

experienced high levels of depression and anxiety, and moderate amounts of unawareness, which was measured by the relative congruence of pre- and post-injury ratings of self. However, Deaton (1986) has suggested that this may not be denial so much as it is an indicator of the slow process of self-concept change. Thomas's (1990) findings also suggest that severe CHI patients have low self-esteem, which is negatively related to depression. Newton and Johnson (1985) reported on the social and psychological adjustment of 11 severe CHI patients, comparing them to normal controls and outpatient psychotherapy patients. They found that CHI patients have significantly lower self-esteem and impaired social adjustment as compared to normal controls.

These studies demonstrate that self-esteem and self-concept are lower in CHI patients, suggesting that investigation of self-concept is warranted.

Self-Concept and Self-Esteem Defined

William James (1890) developed a formula that described self-esteem as being a function of "successes" divided by "pretensions" (beliefs about our own potentialities). With this brief but eloquent formula the modern investigation of self-esteem began. Fueled by the cognitive revolution, there has been a resurgence of interest in self-concept theory, particularly in the field of social psychology (Bednar et al., 1989; Epstein, 1987; Gecas, 1982).

Following a review of the literature on self-esteem Bednar, Wells, and Peterson (1989) reported that there is overwhelming agreement that realistically high self-esteem is a beneficial and desirable personality trait. Some go further to suggest that high self-esteem is essential for mental health (Branden, 1969; Rogers, 1959). However, if one accounts for the importance ascribed to it, self-esteem remains a poorly understood concept, despite some of the recent contributions to self-concept theory (Bednar et al. 1989; Markus & Wurf, 1987).

Gecas (1982) defines the self-concept as "the concept the individual has of himself as a physical, social, and spiritual and moral being" (p. 3). The self-concept for Rosenberg (1979) is defined as the "totality of the individual's thoughts, and feelings with reference to himself as an object" (p. 7) and is itself only a part of the total personality. The self-concept is thus the realm of "self ideas." For Rosenberg (1979) the structure of the self-concept is divided into three areas. The extant self is the current or existing self which represents what one sees when looking in the mirror. In contrast, the desired self is what one aspires to be. The presented self is the self-concept presented to others, which is dynamic, changing and therefore situationally dependent. The content of the self-concept includes social identity (race, sex, social status, and memberships), dispositions (traits, attitudes, beliefs and values) and

physical attributes (body image), all of which can be described and evaluated. Thus, the self-concept is a multidimensional multifaceted construct (Markus & Wurf, 1987; Shavelson, Hubner & Stanton, 1976).

Self-esteem is thought of as the evaluative component of the self-concept, i.e. the valence attached to the various characteristics of the self-concept (Markus & Wurf, 1987; Rosenberg, 1979). Fleming and Watts (1980) suggest that studies have been unable to support a statistical distinction between the evaluative and descriptive aspects of the self-concept because scales which measure "self-esteem" have often been interchangeable with scales measuring "self-concept", suggesting that either better measurements are needed or it may not be possible to distinguish them. However, we shall continue to maintain this theoretical distinction, while reminding the reader that studies often confuse these terms.

Current theories of self-concept portray it as a multidimensional, multifaceted dynamic structure implicated in virtually all social information processing (Markus & Wurf, 1987).

The Dynamic Self-Concept

Markus and Wurf (1987) developed a "dynamic self-concept" model, in which the self-concept is viewed as a collection of self-representations; with a working self-concept that is a subset of representations that are active at any one time.

Self-representations are particular self-conceptions which can vary in importance or centrality to the self. The working self-concept is a continually active, shifting array of accessible self-knowledge, which is involved in goal setting, planning, monitoring, judgement, and self-evaluation when information is relevant to the self (i.e. self-regulatory functions). It is the working self-concept which regulates both intrapersonal (information processing, affect regulation, and motivational processes) and interpersonal (social perception, social comparison, and shaping interactions with others) behavior.

The representations that are active in the working self-concept may invoke what Rosenberg (1979) refers to as self-concept motives; self-enhancement and self-consistency. To these Epstein (1987) adds the motive of maintaining reality contact and assimilating the data of reality. Most often these three motives work in concert, to influence behavior and support the self-concept. These motives have been useful for describing the responses people make in reaction to evaluative feedback. These theories claim that changes in thought, affect or behavior are attempts to maintain either self-consistency, positive self-esteem, and contact with reality. Self-consistency motivation is the desire to maintain a stable self-concept in the face of potentially threatening or contradictory information (Rosenberg, 1979). Because the self-concept is anchored in a broad network of beliefs,

significant changes would destabalize the entire system and cause extreme anxiety (Epstein, 1987). The self-enhancement motive is the desire to seek explanations for behavior which emphasize the positive aspects of the individual. These motives usually act together, with the result of small upward changes in self-concept being the most acceptable. While these motives usually act in concert, there are instances in which they are opposed to one another, such as following a perceived failure. For a relatively high self-esteem person the full acceptance of negative feedback runs counter to self-enhancement motives, and self-consistency demands that the current self-concept be maintained. However, the reality which confronts the individual demands that accommodations be made in the self-concept.

This interaction of motives may explain why dramatic changes in self-esteem are so uncommon and so hard to come by in psychotherapy (Epstein, 1987), and why self-concept is very slow to change following CHI (Deaton, 1986). When the CHI patient is confronted with information about deficits, which is discrepant with premorbid self-conceptions, self-enhancement and self-consistency motives predict that the information should be denied, while the motive to accommodate reality would predict acceptance of the feedback. However, as Epstein (1987) suggests one of the these motives may be sacrificed for another, and reality may be sacrificed in order to maintain self-esteem and stability. In fact, the reason

that reality may get "sacrificed" could be due to an awareness deficit.

In summary, the self-concept is a continually active entity which describes our attributes and characteristics. Self-esteem by contrast is the evaluation of those characteristics. At any one time, there are different elements of our self-concept active which mediate our intrapersonal and interpersonal behavior. The evaluative aspects of self-concept, as just described, would fit into the realm of frontal functions, as described earlier. Epstein (1973) summarized the current perspective on self-concept by claiming that a healthy self-concept organizes the data of experience and maintains self-esteem and when new evidence threatens the self-concept, it is either assimilated (acceptance) or avoided (defenses erected).

Self-Concept, Denial and Awareness Deficits

So far self-concept, denial, and awareness deficits have each been considered in isolation. There have been very few studies which have speculated on the relationship between awareness, denial, and self-concept in CHI. Deaton (1986) devoted an entire monograph to ".. the type of denial that is characterized by a failure to change one's self-concept despite adequate information following an injury, and that acts as a psychological defense."(p. 232) The denial to which she was referring includes both psychological denial and

neurological awareness deficits. (In this document the phrase "self-knowledge of deficits" has been used as a supraordinate construct to encompass both psychological denial and awareness deficits.) Of awareness deficits she states "..damage to the brain disrupts self-concept and cognition, resulting in an unawareness of deficits that is organically mediated."(p. 232) The relationship between the self-concept, awareness deficits, and denial is captured in a statement made by Ford (1976) (cited in McGlynn and Schacter, 1989) who suggested that following head injury the patient will deny intellectual impairments and "at first he will identify with his own premorbid self-image, and only after many destructive failures comes to see he is not the man he was" (p. 603). This statement hints at the transformation of the self-concept as the patient recovers but it assumes that the patient does not have an awareness deficit which would preclude the self-concept change from taking place.

Crosson (1987) suggests that in the rehabilitation environment one of the manifestations of denial may be that the patient will not begin to apply compensations to their behavior because the compensation does not fit their self-concept. There is abundant evidence which suggests that defensive processes are activated in order to maintain self-esteem (Harder, 1984). Denial is also thought to be proportional to the threat posed to one's self-esteem (Levine & Zigler, 1975) and may allow patients to maintain self-esteem

and self-concept stability (Deaton, 1986; Markus & Wurf, 1987). Some studies show that when evaluative feedback is incongruent with the self-concept it will be distorted, rejected, and considered less credible (Shrauger & Terbovic 1976). Denial serves a function for CHI patients, just as it does for the non-head injured person. There are several studies with normals which suggest that maintaining an overly optimistic attitude and positive self-evaluation (similar to the "rosy glow effect") is related to psychological health (Taylor & Brown, 1988). Bednar, Wells and Peterson (1989) present a model which suggests that consistent high self-esteem is maintained by the process of coping with the sources of negative evaluative feedback, rather than avoiding the feedback. Deaton (1986) suggests that, following CHI, denial is activated as a result of stability needs, i.e. the desire to maintain the old self-concept at the cost of neglecting facts relevant to the self. Denial is thus activated in order to protect the self-concept; however, coping with the negative feedback may be necessary in the long run in order to maintain self-esteem. In this case, awareness is assumed to be intact enough to allow comparisons to be made between the pre-morbid self-concept and currently impaired status (Allen & Ruff, 1990) in order for denial to be activated.

Because self-awareness is necessary for self-conception (Carver & Scheier, 1982) there are instances in which CHI patients are unable to become aware of the conflict between

their old self-concept and current status; thus, these patients are rendered unable to form new self-concepts. As mentioned previously, CHI frequently results in damage to the frontal lobes causing self-monitoring and self-awareness deficits. Self-awareness deficits are impairments in judging the significance of an event for the self. More abstractly, it involves the inability to integrate and maintain two or more representations simultaneously, which is partly dependent upon intact working memory. Impairment of working memory, then, may be one reason why CHI patients have difficulty changing self-concept (Goldman-Rakic, 1992). This is characterized by Prigatano (1991) as the "experience of normality despite brain damage, coupled with the simultaneous perception of an altered sense of self" (p. 112). Given that frontal damage often causes impairments in working memory and therefore self-awareness, it is intriguing to consider the similarities between the model of self-concept presented by Markus and Wurf (1987) and Stuss and Benson's (1986) model of frontal lobe functioning. For example, the frontal lobe functions (such as self-monitoring, self-regulation, and self-awareness) proposed by Stuss and Benson (1986) are nearly identical to the functions of Markus and Wurf's (1987) working self-concept. The regulatory functions such as formation, initiation, enacting, and monitoring of goals are functions ascribed to both models. The working self-concept is also a dynamic entity which mediates most behavior, much the same way

working memory controls or regulates behavior. Working self-concept is also of limited capacity. Working self-concept may in fact be a component of the complete working memory active at any one time. It is in this regard that awareness deficits, particularly "self-awareness" deficits, result in deficits in self-conception. A self-concept deficit is the acquired inability to alter self-concept due to neurological impairment.

Considering the relationship between denial, awareness deficits, and self-concept, the common element is that both denial and awareness deficits result in decreased self-knowledge. In the case of denial, threatening information is avoided in order to protect the premorbid self-concept while awareness deficits inhibit information from gaining access to the premorbid self-concept.

Psychological Distress Following Closed Head Injury

Psychological distress is a negative affective reaction to the underlying psychological or neurological pathological state of an organism. As mentioned earlier, emotional distress is common following CHI. Prigatano (1987) suggests that management of emotional disorders is essential for successful patient outcome. Depression, anxiety, and catastrophic reactions may be due to a reactive maladjustment to illness, neurological insult, or a combination of these factors (Crosson, 1987). Anderson and Tranel (1989) suggested

that emotional expression may actually be disrupted by the same lesion which causes an awareness deficit, because patients are unable to be anxious about a deficit about which they do not know. However, while a severe awareness deficit would preclude awareness of deficits, patients may be able to understand that undesirable changes have occurred, though they cannot make a connection to their own deficits. Therefore, emotional functioning may be affected by either reactive or neurological factors, particularly denial and awareness deficits. Fordyce and Roueche (1986) found a negative relationship between awareness deficits and psychological distress (also see, Olson, 1990). Boake, Freeland, Ringholz, Nance, and Edwards (1987) studied 34 severely head-injured patients and confirmed the lack of association between self-rating of memory performance and actual memory performance found in the Sunderland et al. (1983) study. In addition, the Boake et al. (1987) study showed a significant relationship between self-rated memory impairment and emotional distress (measures of depression and anxiety). They found that those rating more memory impairment were more distressed, suggesting that patients that are more unaware are less emotionally distressed. Emotional distress usually increases as the level of awareness of injury increases and self-esteem decreases.

Studies of CHI patients frequently demonstrate greater emotional distress as time since onset of illness increases (Alfano, Neilson, Paniak & Finlayson, 1992; Fordyce, Roueche

& Prigatano, 1983; Levin & Grossman, 1978; Lishman, 1979). Fordyce et al. (1983) found that chronicity of CHI was positively associated with depression and anxiety on the MMPI, despite equivalent severity of dysfunction (length of coma) and level of neuropsychological functioning. Emotional distress following CHI also portends later maladjustment (Levin, Benton & Grossman, 1982). The most common emotional reactions to CHI are depression and anxiety.

Depression is a common negative emotional reaction following brain injury (e.g. Code, 1986; Fordyce & Roueche, 1986; Fordyce, Roueche & Prigatano, 1983; Gainotti, 1972; Lishman, 1978; Prigatano, 1987; Robinson, Kubos, Starr, Rao & Price, 1984; Schoenhuber & Gentilini, 1988), which may be the result of failure to live up to one's own ideal self (Higgins, Klein & Straumann, 1985). Depression is usually in response to the various cognitive and physical deficits following CHI (Prigatano, 1986a). Thomas (1990) found that over half of 47 severely head-injured patients questioned had mild to severe depression. Utilizing the Brief Psychiatric Rating Scale (BPRS) with CHI patients, Levin, Benton, and Grossman (1982) found depression to be relatively common at long-term follow-up. Armstrong (1991) found that patients with cerebral dysfunction were distinguished by their diminished self-esteem, and elevated depression and anxiety as measured on the MMPI. Tyerman and Humphrey (1984) also found CHI patients to be depressed. Alfano et al. (1992) found that the most

commonly elevated scale on the MMPI is the Depression scale (Scale 2), suggesting that severe CHI patients experience significant depression.

Lewis and Rosenberg (1990) report that patients with brain injury suffer from high levels of anxiety, which is one of the primary reasons for psychotherapeutic treatment. Anxiety following CHI is frequently the result of a failure to cope with environmental demands which results in altered emotional functioning such as a catastrophic reaction (Goldstein, 1952). In comparison to depression, Higgins et al. (1985) find that anxiety may be the result of a discrepancy between the "ought" self (what you should be) and real self. Working with severe CHI patients, Levin, Benton and Grossman (1982) found severity of injury to be positively related to level of anxiety immediately and at long term follow-up. Newton and Johnson (1985) also found that chronic severe CHI patients suffer from severe anxiety. Lishman (1978) reports that chronic anxiety following CHI is a common reaction. Similar to the relationship with depression, it has been suggested that as the level of awareness of deficits increases, anxiety also increases (Lewis & Rosenberg, 1990).

RATIONALE FOR THE STUDY

Statement of the Problem

The combined impact of CHI is devastating. Virtually every aspect of the patient's life is negatively affected, including cognitive, physical, and social functioning. Some of the most common cognitive and emotional sequelae of CHI involve impaired awareness of deficits, low self-esteem, and psychological distress. There may be several sources of unawareness (or decreased self-knowledge). Decreased self-knowledge of deficits may be due to a process of denial in reaction to illness, or it may be the result of an incapacity to be aware due to the neurological injury. Decreased self-knowledge of deficits may be for motor impairments, or complex cognitive deficits. The latter have come to be termed self-awareness deficits, and are thought to be the result, at least in part, of frontal damage. Frequently, deficits in awareness and denial occur in combination, and they have proven very difficult to differentiate.

In addition to problems of awareness, problems of self-esteem and self-concept are common. It has been reported that CHI patients have low self-esteem, and it has been suggested that CHI sequelae represent a threat to the patients self-concept. All of the drastic changes which occur to patients

have consequences for their sense of self. Denial and awareness deficits can be viewed as the psychological and neurological mechanisms, respectively, which either diminish or preclude self-knowledge of current functioning, which in turn may impact self-concept/self-esteem. As with many other drastic life changes, it is assumed that following CHI the self-concept must go slowly through a stage of transition. Some individuals may make this transition easily; others experience great difficulty; and a few are unable to make this transition at all. The reason for this variability in self-concept change is the result of competition between the motives of self-enhancement, self-concept consistency, and accommodations with reality which is itself dependent upon the capacity of the patients to be aware of changes they have undergone.

Depression and anxiety are common for CHI patients, unless protected by denial and unawareness. Studies demonstrate that distress is higher when awareness is high and when self-esteem is low.

Though the relationship between these variables is complex, there has been virtually no theory which relates them. The impact of gaining a greater understanding of awareness deficits, denial, self-esteem, and psychological distress following CHI is significant. The focus of this study is on the relationship between awareness deficits, denial, comparative self knowledge, and self-concept.

However, since the self-concept is a multidimensional, multifaceted construct (Markus & Wurf, 1987; Shavelson, Hubner & Stanton, 1976), separate dimensions of self-concept will be evaluated (physical, cognitive, and social self-concept).

An experimental model is proposed (see Figure 1) which attempts to specify the relationships outlined above in the form of a path model and path diagram. It should be noted that the direct measurement of awareness deficits is deferred for the experimental model, primarily because quantitative measures which isolate this construct do not currently exist. Barco, et al. (1991) suggest that awareness deficits can be assessed; however, assessment involves qualitative observations during extensive treatment. Unfortunately, this state of affairs discourages measurement for the present study. Nonetheless, as the literature review attests, knowledge of awareness deficits is important, which is why we included it in the full model. We are attempting to measure awareness deficits indirectly by choosing cognitive measures which have a probability of being related to the awareness dimension. This path analysis model concerns the relationship between cognitive deficits which are thought to underlie awareness deficits, denial, comparative self-knowledge and self-concept/self-esteem. As previously mentioned, self-concept and self-esteem are interdependent constructs. In

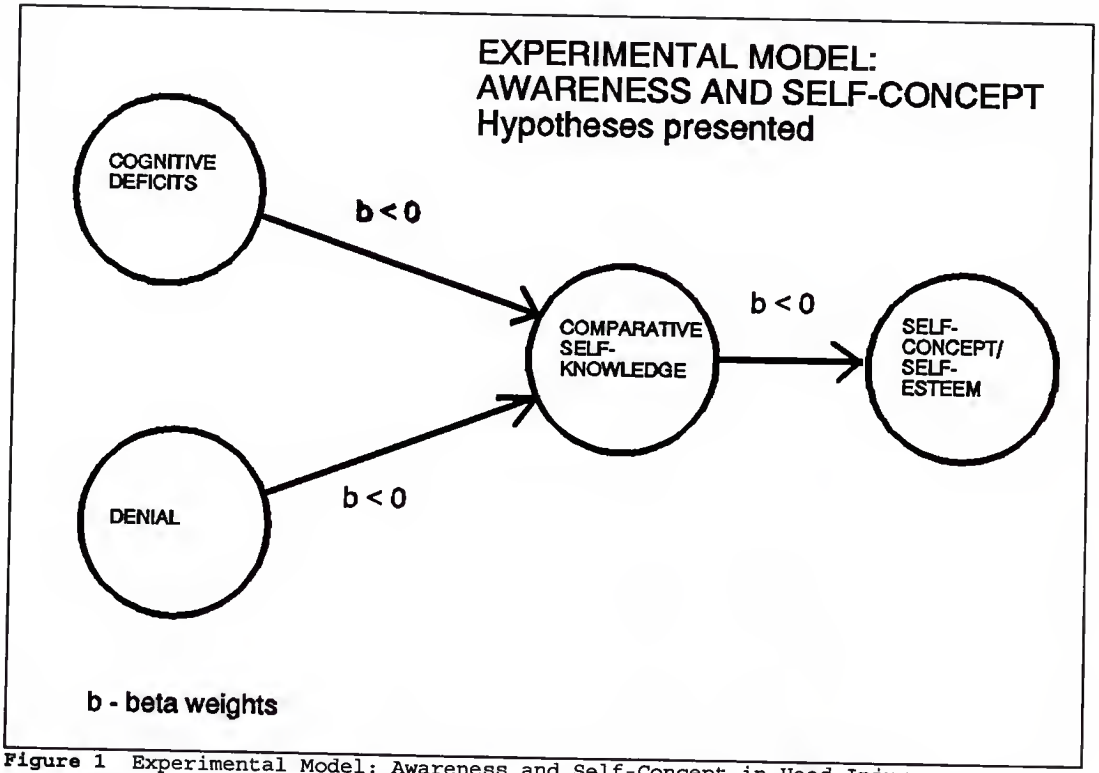


Figure 1 Experimental Model: Awareness and Self-Concept in Head Injury

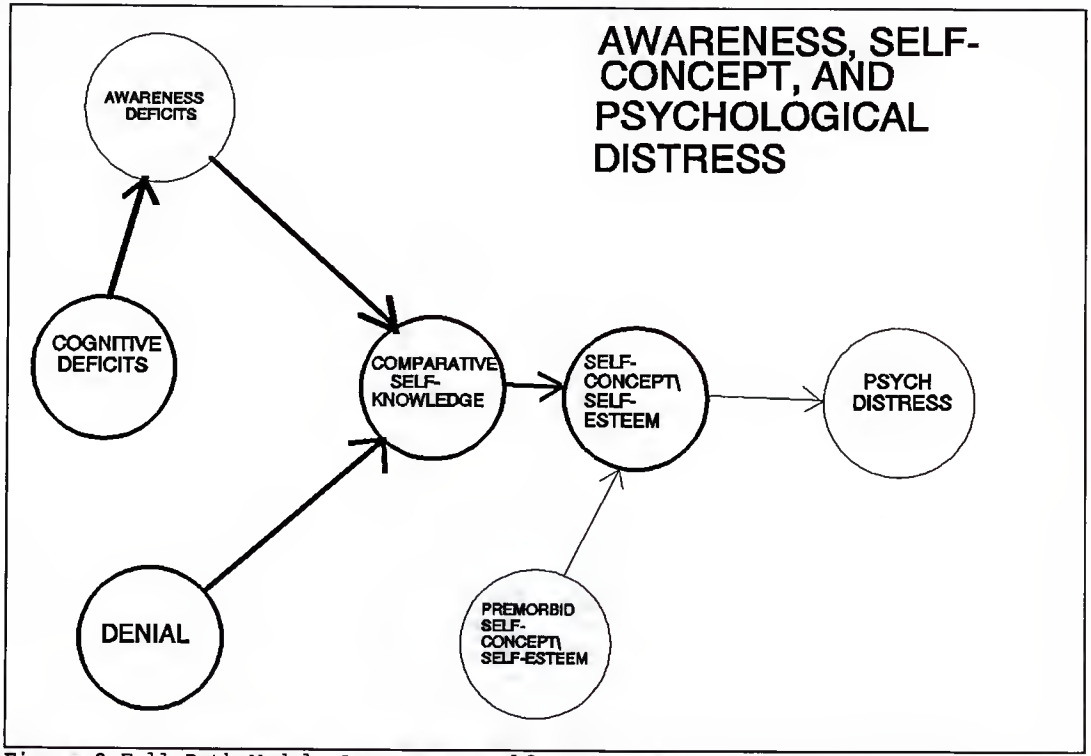


Figure 2 Full Path Model: Awareness, self-concept and psychological distress.

addition, current measurement of self-concept is confounded with measurement of self-esteem. Therefore, for the present study we have decided to combine these constructs into a supraordinate construct called self-concept/self-esteem which encompasses self-descriptions and self-evaluation. Experimental hypotheses will be made concerning this model and a second model is presented (see Figure 2) which provides the wider context for the first model. All variables in the second model which are highlighted in **bold** represent the portion of the model being tested. Based on the literature review the second model predicts the relationship between cognitive deficits which are thought to influence awareness deficits, comparative self-knowledge, current and premorbid self-concept/self-esteem, and psychological distress. The wider model states that cognitive deficits which influence neurologically mediated awareness deficits have an impact upon comparative self-knowledge. Likewise, psychological denial has an influence upon comparative self-knowledge. Next, comparative self-knowledge influences the self-concept/self-esteem. Awareness deficits and denial have an influence upon self-concept/self-esteem but indirectly through comparative self-knowledge. The wider model also posits that self-concept/self-esteem is influenced by premorbid levels of self-concept/self-esteem. The final part of the model is the influence of current levels of self-concept/self-esteem, and all its' influences, on level of psychological distress.

Although experimental hypotheses for the second model are beyond the scope of this study, it is important to understand how cognitive deficits, denial, and unawareness may ultimately affect self-esteem and psychological distress through comparative self-knowledge and the self-concept. The present study is designed to assess the first experimental model, which examines the relationship between cognitive deficits, denial, comparative self knowledge, and the dimensions of self-concept/self-esteem.

Hypotheses

There are several experimental hypotheses which emerge from the forgoing discussions. Figure 1 presents the experimental path diagram and the following hypotheses are presented:

1. Considering the relationship between cognitive deficits which underlie awareness deficits and denial it is hypothesized that cognitive deficits are unrelated to denial. Denial is a trait which may be expressed under situations of stress and should not logically have any influence upon cognitive deficits which underlie awareness deficits. In addition, cognitive deficits as presented in the model are attempting to indirectly assess awareness deficits, and if patients have a neurologically mediated incapacity to be aware, which is indicative of an awareness deficit, there would be no need for denial.

2. Based on the literature and theoretical assumptions it is predicted that as cognitive deficits which underlie awareness deficits increase, comparative self-knowledge of deficits will decrease. Thus, cognitive deficits should be negatively related to comparative self-knowledge.

3. Based upon the literature review and theoretical assumptions, psychological denial is thought to influence the level of a patients self-knowledge. It is hypothesized that as denial increases comparative self-knowledge will decrease. Therefore, it is predicted that denial will be negatively related to comparative of self-knowledge.

4. Self-concept/self-esteem is thought to be influenced by the level of awareness that a patient possesses. However, as previously mentioned cognitive deficits which underlie awareness deficits and denial are thought to have a common effect upon comparative self-knowledge. It is assumed that since CHI results in several dramatic changes in functioning, self-knowledge of these deficits will result in lowered self-concept/self-esteem. It is hypothesized that as comparative self-knowledge increases, self-concept/self-esteem will decrease, i.e. greater knowledge of deficits results in lower self-concept/self-esteem ratings (Kihlstrom & Tobias, 1991; Tyerman & Humphrey, 1984). This relationship is predicted to exist for the physical, social and cognitive self-concept/self-esteem.

5. In addition, cognitive deficits and denial are assumed to have indirect relationships upon self-concept/self-esteem, i.e. mediated through the level of comparative self-knowledge. Therefore, there should not be any direct relationship between cognitive deficits which underlie awareness deficits or denial and the different dimensions of the self-concept/self-esteem.

METHODS

Subjects and Selection Criterion

Subjects were 57 adult patients with severe closed head injury undergoing rehabilitation between 1993 and 1995. The majority of subjects (89%; N=51) were tested while attending the inpatient and outpatient brain injury rehabilitation programs at Genesis Rehabilitation Hospital (Formerly Memorial Rehabilitation Hospital) in Jacksonville, Florida and six subjects were tested while attending Transitions of Long Island in New York. Subjects were included in the study if they had a severe closed head injury and were between the ages of 18-55. Closed head injury was defined as non-missile impact of a moving object striking the relatively stationary head, the head being decelerated by a relatively stationary object, and injury due to rapid acceleration-deceleration and rotational forces (Levin, Benton & Grossman, 1982). Therefore, all closed head injuries, including depressed skull fractures, were included and those with penetrating localized wounds were excluded. Severity of injury was assessed by either admitting Glasgow Coma Scale (GCS) score, length of post-traumatic amnesia (PTA), or length of coma. Subjects were included if they met at least one of three criteria, (a) admitting GCS score of 8 or below (Jennett & Teasdale, 1977;

Levin, Benton & Grossman, 1982), (b) PTA greater than 48 hours (Jennett, Snoek, Bond & Brooks, 1981; they report that of a sample of 1000 severely head injured patients, the minimal length of PTA for the survivors was two days; severe injury in this study was defined by presence of coma for 6 or more hours) or (c) coma greater than 6 hours (Jennett & Teasdale, 1977; Jennett et al., 1981). The generally accepted definition of coma is not opening eyes, not obeying commands, and not uttering words (Jennett & Teasdale, 1977). PTA is defined as the period of time from the onset of trauma to the establishment of consistent ongoing memory (Lishman, 1978) defined here as a weekly aggregate score of 2.78 or greater on the Orientation Group Monitoring System (OGMS; Corrigan, Arnett, Houck & Jackson, 1985) for two consecutive weeks (PTA ends at the end of the second week). However, not all subjects were referred to the orientation group. They were referred for group monitoring if they scored a 5 or below on the Orientation/Reality testing item from the Functional Assessment Scale (Brain Injury Programmatic Development Committee of Memorial Regional Rehabilitation Center, 1991) upon admission to the hospital. This level of orientation is consistent with the achievement of Level VII or greater on the Ranchos Los Amigos Hospital Levels of Cognitive Functioning Scale (Corrigan et al, 1985). (see measurement instrument section for explanation of the Ranchos Los Amigos scale).

Patients were also excluded if there was an alexia which precluded accurate responding to the questionnaire items. In order to screen for deficits in reading comprehension the Reading Sentences and Paragraphs subtest of the Boston Diagnostic Aphasia Exam (BDAE) was administered. Patients were excluded if they scored less than 7 out of 10 correct.

Demographics

Table 1 lists the demographic variables of the subjects. The majority of subjects were male (N=42; 74%), caucasian (N=47; 82%) and with at least a high school education (M=12.29, sd = 2.07). The average age for the subjects was 28.33 (sd = 9.58) years old with age ranging from 18 to 51 years old.

Table 1

Means Values for Demographic Variables

VARIABLE	N	MEAN (SD)	Range
Age	57	28.32 (9.58)	18-51
Education	56	12.29 (2.07)	8-19
Days Since Onset	57	117.72 (161.67)	12-1008
PTA (days)	41	45.02 (38.94)	3-158
Admitting Glasgow Coma Scale	46	6.37 (3.28)	3-15
Length Coma (days)	23	19.74 (23.81)	1-92

The admitting GCS score was available for 46 subjects. The average admitting GCS for these subjects was 6.37 (sd = 3.28). The average length of coma for those whom we were able to obtain this information (N = 23) was approximately three weeks or 20 days (sd = 23.8). The average length of PTA for those on whom we were able to obtain this information (N = 41) was about six and one half weeks or 45.02 days (sd = 38.94). Most subjects were tested less than 6 months since the onset of their injury (M = 117.72; sd = 161.67). Most subjects reported a right handed motor preference (79%). The distributions for length of coma in days and length of PTA are shown in Table 2.

Table 2

Distribution of Coma and PTA Length

Length of Coma (days)	0-1	2-3	4-7	8-14	15-30	>30	M	SD	N
n	1	3	6	6	3	4	19.74	23.81	23
Length of PTA (days)	**0-3**	**4-7**	**8-14**	**15-30**	**31-60**	**>60**	**M**	**SD**	**N**
n	2	3	3	9	15	9	45.02	38.94	41

Information about premorbid medical and psychiatric conditions was obtained from the medical record. The medical records suggest that the subjects did not have significant medical or psychological disorders prior to their hospitalization. A review found that 74% (N=42) of the sample

did not have any major medical condition. The most common condition was a history of alcoholism (19%, N=11). One subject had a previous head injury (1.7%), another had diabetes (1.7%), another had hypertension (1.7%) and one other had a history of drug abuse (1.7%). With respect to psychiatric history 97% (N=55) did not have a diagnosable psychiatric disorder. One subject had a history of major depression (1.7%) and another had some form of psychotic disorder (1.7%). It should be pointed out that these figures are likely to underestimate the incidence of previous medical and psychiatric conditions because of the archival method of data collection. For example, Corrigan (1995) reviewed the literature on substance abuse in a Traumatic Brain Injury and found that the incidence of prior substance abuse was between 16% - 66%. He states that the lowest incidence levels were reported from studies which used a retrospective medical record review, similar to that used in this study.

Group differences

In order to test whether there is any difference between the subjects obtained from Transitions of Long Island and those subjects that were collected from Memorial Rehabilitation hospital, t-test comparisons were made for demographic variables (age, education, and days since onset), severity variables (Glasgow Coma Scale score, length of coma in days; Note: length of post-traumatic amnesia was not

available for Transition subjects), and the variables used in path analyses (cognitive deficits, denial, comparative self-knowledge, cognitive self-concept, social self-concept, and physical self-concept).

In order to determine whether inclusion of the Transition subjects changed the results of the study significantly, an inspection of the correlation matrix with and without the Transition subjects was conducted.

Since several subjects received only the Dn scale and the R-scale from the MMPI-2 instead of the full MMPI-2, analysis was conducted to determine whether there was any difference between the scores of those that completed the full MMPI-2 and those that only completed the two subscales. We administered both the short version and the long version to 18 subjects and compared the average t-scores obtained from the long and short versions for these subjects.

When the standardized t-scores were compared for 18 subjects that completed both the full MMPI-2 and the individual scales (Dn scale, and R-scale) it was found that there was no difference between the mean scores for the combined denial variable. The average t-score for the combined Dn scale and R-Scale that was completed as part of the complete MMPI-2 was 53.04 and the average t-score for the short version was 52.92. The average t-score difference between the complete administration and the shortened version was 0.12 points. This suggests that for those subjects that

only had the short version there should not be any significant differences between those that had the complete MMPI-2.

Procedures

The admitting Glasgow Coma Scale score was rated by the on-call physician for the trauma team following admission to the hospital and the score was obtained from the medical record. This initial rating was used as one of the classifications of severity of head injury and if it was unavailable the other criteria were used (Length of coma, and Length of PTA). When patients arrived from other hospitals or rehabilitation facilities, GCS scores and length of coma (LOC) were frequently unavailable, therefore, PTA was used to define severity as outlined by the criterion mentioned below. If the three criteria (PTA, LOC, and GCS score) are unavailable patients were excluded from the study.

The length of PTA was monitored by a clinical neuropsychologist. Once they are out of PTA (by achieving a 2.78 or greater on the OGMS for two consecutive weeks or being at a Level VII or greater on the Rancho Levels of Cognitive Functioning Scale) they were given a routine neuropsychological evaluation, which includes the MMPI-2 and neurobehavioral testing (WMS-R, WCST, Trails A and B, Sentences and Paragraphs from the Boston Diagnostic Aphasia Examination). The study was approved by the Institutional Review Boards at the University of Florida Health Science

Center and Long Island Jewish Medical Center. Informed consent was obtained from each patient; patients were administered the PCRS, AGSCI, the Auditory Consonant Trigrams, and the Feeling-of-Knowing (FOK) paradigm within one week of the full examination. Patients that did not receive the complete evaluation were administered the tests for this study. At Memorial Rehabilitation Hospital the patient's occupational therapist completed the staff PCRS and at Transitions of Long Island the patient's life skill trainers completed the staff PCRS. Confidentiality for each patient was ensured by replacing patient names with a subject number for use in the database.

Measurement Instruments

Severity measures

Glasgow Coma Scale. The Glasgow Coma Scale is a widely used and valid instrument to evaluate the severity of head trauma (Jennett & Teasdale, 1977; Levin, Benton, & Grossman, 1982). The patient is evaluated according to three criteria, (a) best motor response, (b) best verbal response, (c) eye opening, and assigned a score which can range from 3 to 15. An admitting GCS score of 13-15 is considered a mild head injury, 9-12 is considered moderate, and 3-8 is considered severe.

Orientation and Group Monitoring System. The OGMS was used to estimate the length of post-traumatic amnesia (PTA).

The OGMS consists of observations of the patients in a group setting while being rated on seven dimensions: orientation to place, orientation to time, identities of staff and group members, associative learning, ability to attend to group activities, episodic recall of the previous day, and ability to accurately utilize environmental cues. Staff members that run the daily group rate the patients on a 3-point scale for each of these dimensions and scores are averaged for the week. The OGMS has adequate reliability and validity. Corrigan, Arnett, Houck, and Jackson, (1985) report an interrater reliability coefficient of .875 for the OGMS. Weekly aggregate scores of greater than 2.75 have been found to meet the classic definition of clearing PTA (Corrigan & Jackson, 1984; Corrigan et al., 1985; Jackson, Mysiw & Corrigan, 1989; Mysiw, Corrigan, Carpenter & Chock, 1990). In a sample of severe closed head injury patients, Mysiw, Corrigan, Carpenter & Chock, (1990) compared the duration of PTA on the OGMS and the Galveston Orientation and Amnesia Test (GOAT) and found 71 percent agreement, demonstrating adequate concurrent and construct validity for the OGMS as a measure of PTA duration. Mysiw et al. (1990) add that relative to the GOAT the OGMS is more conservative, i.e. yields longer PTA durations. Further validity evidence is provided by Jackson, et al. (1989) who found that a change of .23 or greater in weekly aggregate scores to be a sensitive and reliable

indicator of medical complications (most often medications) which impact cognitive functioning.

Ranchos Los Amigos Hospital Levels of Cognitive Functioning Scale. The Ranchos Los Amigos Hospital Levels of Cognitive Functioning Scale was developed to track the recovery of patients from brain injuries (Hagen, Malkmus & Durham, 1979) and is widely used in brain injury rehabilitation. The scale has eight levels. Level I is labeled "No Response" and is consistent with coma and non-responsiveness. Level VIII is labeled "Purposeful-Appropriate" and is consistent with a patient that is purposeful and responsive to the environment, but may still have some cognitive deficits. Level VII is labeled "Automatic-Appropriate" and is consistent with patients that are purposeful, but behave automatically in their daily routine. They have cleared post-traumatic amnesia but still may be confused in unstructured situations and frequently have deficits in cognitive functioning. The scale is used primarily to track the recovery of responsiveness, but the scale has also been used to predict long term outcome of head injury patients (Shin, Ehrenberg, Whyte, Bach & DeLisa, 1989), and to monitor agitation and response to medications (Mysiw, Jackson & Corrigan, 1988). The scale has shown adequate test-retest and interrater reliability, and adequate concurrent and predictive validities in its ability to monitor recovery from head injury (Gouvier, Blanton, LaPorte & Nepomuceno, 1987).

Reading Sentences and Paragraphs subtest. The Reading Sentences and Paragraphs subtest of the Boston Diagnostic Aphasia Exam (BDAE) has 10 sentences or paragraphs which require the inclusion of either a key word or phrase to complete the sentence or paragraph. The appropriate word or phrase is chosen from a list of four. Borod, Goodglass & Kaplan (1980) present norms for this subtest and state that scores below seven suggest impairment in reading comprehension.

Cognitive deficit measures

Figure 3 shows the variables used to measure the latent constructs as well as the five cognitive variables which are thought to underlie awareness deficits (though we are not measuring awareness deficits directly). The choice of tests used to measure these cognitive deficits were chosen on the basis of their ability to measure the elementary information processing requirements for an awareness of a deficit. In other words, the cognitive skills that may be related to awareness deficit.

In addition to the various functions and deficits of which patients can potentially be unaware, there are several strategies that can be used to report an awareness deficit. For example, when asked about their poor memory, patients

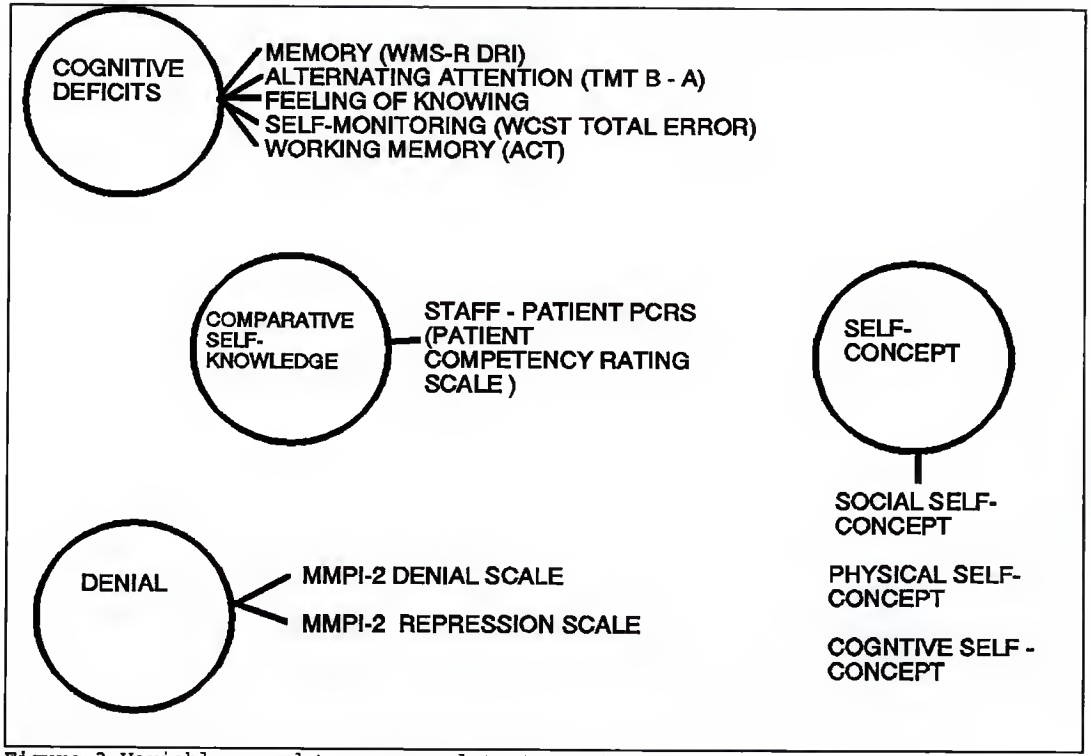


Figure 3 Variables used to measure latent constructs.

could be attempting to recall prior instances of poor memory performance since the accident, or they could be assessing present memory functioning. Thus, attempts were made to choose tests which assessed these various abilities, including alternating attention (Sohlberg & Mateer, 1989), long-term memory (Schacter, 1991), metamemory (Shimamura & Squire, 1986), abstract reasoning (Barco et al., 1991), self-monitoring (Goldberg & Barr, 1991; Stuss, 1991), and working memory (Cowan, 1988; Baddeley, Logia, Bressi, Della Sala & Spinnler, 1986). These are the cognitive functions which may underlie awareness deficits. The five measures include the Wechsler Memory Scale -Revised, Wisconsin Card Sorting Test, Trail Making Test, Auditory Consonant Trigrams, and a Feeling-of-Knowing Procedure. Scores were converted to z-scores and reversed when necessary (WMS-R Delayed Recall, Auditory Consonant Trigrams, and the Feeling of Knowledge Procedure) so positive values represented greater cognitive deficits which are thought to underlie awareness deficits. The z-scores were then combined and averaged to form a single variable which represents cognitive deficits.

Wechsler Memory Scale - Revised: Delayed Recall Index. The delayed recall index from the WMS-R was used as a measure of long-term memory storage ability. The WMS-R (Wechsler, 1987) is a revision of the original Wechsler Memory Scale. It is used clinically to appraise the major dimensions of memory function in adults and adolescents. The revision was

undertaken because there were several inadequacies with the test, which included inadequate norms, combination of all subtests into a unitary memory quotient, too much reliance on immediate recall without delayed recall assessment, stress on verbal versus non-verbal tests, and inclusion of non-memory tasks (e.g. orientation).

The WMS-R has thirteen subtests, from which 5 standardized indexes can be obtained. The Delayed Recall Index of the WMS-R is a composite of the delayed Logical Memory subtest, delayed Visual Reproduction subtest, and delayed Visual and Verbal Paired Associate subtests. Thus, the Delayed Recall Index measures the long-term verbal and non-verbal memory capacity of the patient, which is thought to be particularly sensitive to memory impairments (Roth & Crosson, 1985; Wechsler, 1987). Wechsler (1987) reviews studies which provide validity for the Delayed Recall Index of the WMS-R for the assessment of memory impairments in head injury patients. For a group of CHI patients the Delayed Recall Index was the lowest index on the WMS-R, suggesting that delayed memory is significantly impaired for CHI patients (Wechsler, 1987). The Delayed Recall Index has an internal consistency reliability coefficient of .77, and a test retest reliability of .84.

Since evidence suggests that impaired memory may contribute to unawareness (Schacter, 1991) the Delayed Recall Index is chosen as a measure of degree of memory impairment

(i.e. the patients capacity to store information following a delay).

Wisconsin Card Sorting Test. The Wisconsin Card Sorting Test (WCST) is a sorting test in which there are four key cards and a deck of 128 cards that have different shapes, colors and number of shapes (e.g. four blue circles). The subject is given the deck of cards and told to try to match them to the stimulus cards. They are told whether they are correct or incorrect. They are not told the sorting principle (color, shape, or number), and the sorting principle changes five times once they get 10 consecutive correct.

The WCST measures the ability to abstract, i.e. sort cards according to a principle of class membership. This can be considered a measure of abstract reasoning ability (Heaton, 1981) because it requires that patients cognitively remove themselves from the immediate stimulus pull of the cards and consider the abstract principle that is operative. As presented by Goldberg and Barr (1991) the reasoning process is likely to occur at about the same time the comparison process occurs in their error monitoring scheme, i.e. when feedback regarding performance is being compared to the "desired behavior." As mentioned previously, awareness deficits may occur as a result of abstract reasoning deficits and anticipatory awareness is likely to suffer the most as a result (Barco, 1991). Therefore, it is assumed that the process of abstract reasoning that is required on the WCST is

related to the capacity for anticipatory awareness (Barco et al., 1991).

While testing abstract reasoning ability, the WCST has frequently been used as a measure of perseveration, and studies show that perseverative errors differentiate the presence or absence of brain damage and frontal from non-frontal patients (Robinson, Heaton, Lehman & Stilson, 1980). Total errors was the dependent variable. Total errors includes errors that are due to perseverative responses, which therefore reflects the ability to shift set and monitor errors, and errors that are non-perseverative. Non-perseverative errors are errors which are not due to some consistent principle. There can be several reasons for non-perseverative errors. They could be responding to some other principle other than the previous principle, such that they are stuck on one of the features of the cards and cannot utilize feedback to rectify responses. Given enough responses these errors will also result in perseverative errors. Non-perseverative responses may also be the result of breaking set, i.e. maintaining a run of correct responses followed by an incorrect response before the 10 correct limit is met. Because total errors includes perseverative and non-perseverative errors, it is a better indicator of the patients' ability to utilize environmental feedback to modify unsuccessful performance, i.e. to monitor the relationship between their responses and the feedback. This process of

monitoring during the WCST is an analogue for the process of error monitoring required to be aware of a deficit (Goldberg & Barr, 1991).

Therefore, total errors from the WCST was used to assess the patients error monitoring capacity as well as abstract reasoning capacity (Heaton, 1981). In support of the use of total errors from the WCST as a component of awareness, Bergquist and Malec (1993) found that head-injured patients with decreased awareness (as measured by Staff/Patient discrepancy on the PCRS) had significantly more total, but not perseverative, errors on the WCST.

Trail Making Test. The Trail Making Test is widely used measure of visuomotor attentional functioning. Trails A requires the patient to trace a line to follow a sequence of letters and Trails B requires they follow a sequence of letters alternating with numbers. Lezak (1983) suggests that the discrepancy between Trails A and B will give a measure of multiple tracking and rapid alternating attention. This also indirectly measures working memory with the demand of recalling the last digit and letter completed. Trails A is primarily measuring visual-motor tracking, while Trails B is measuring visual-motor and mental tracking. By subtracting the total time of A from the total time of B, this score will therefore represent a measure of mental flexibility and the ability to attend to two stimuli simultaneously (alternating attention). This ability is presumed to underlie the

dysfunction seen in awareness deficits because in order to be aware of deficits, the patient must hold information in mind about current status while making comparisons to some internal standard regarding level of performance.

Auditory Consonant Trigrams. The Peterson and Peterson (1959) Auditory Consonant Trigrams (ACT) procedure was administered to the patients. The ACT was originally designed as a laboratory measure of short-term memory under interference conditions. It is a widely used test of auditory short-term/working memory and is thought to be particularly sensitive to auditory divided attention deficits. The task involves the presentation of three consonants with instructions to recall them across a delay of 3, 9, or 18 seconds. However, during the delay patients are required to count backwards, in order to reduce rehearsal. Patients are given trials without interference to facilitate training in the task. There are five trials at each delay. The score at each delay can range from 0 - 15. Total score can range from 0 - 45.

Baddeley and Hitch (1974) present a model of working memory in which there is a controlling central executive which has several slave systems with access to passive storage. Cowan's (1988) model also posits a central executive; however, in this model the central executive controls or activates a subset of short-term memory for active consideration which is considered working memory. In this model the Peterson and

Peterson (1959) paradigm was chosen as a measure of verbal working memory (Baddeley, Logie, Bressi, Sala & Spinnler, 1986; Cowan, 1988) because the capacity to store information while simultaneously processing a heavy cognitive load is assumed to be a function of working memory under the control of a central executive. It measures the short-term forgetting of verbal units of information and rapid decay. This is an ability which appears to be essential for a constant state of on-line awareness of one's abilities and weaknesses. If a patient has a severe deficit in the ability to maintain information across a short delay, it is likely to impair the ability to hold incoming information about the status of functioning in active storage while comparison is made with long-term memory standards of performance. There was some concern whether all CHI patients would be significantly impaired on this task and therefore not show any variability. Stuss, Stethem, Hugenholtz, and Richard (1989) administered the ACT to CHI patients of various levels of severity and found that patients were impaired on the task relative to controls; however, they demonstrated more variability in the total score than control subjects, suggesting that this measure is adequate for use with CHI patients. Stuss et al. (1989) also found that the ACT was a sensitive predictor of PTA, and length of coma. It also significantly differentiated between a mild head injury, severe head injury, and normal controls. Their study also suggested that the ACT has the

ability to distinguish between chronic and recent head injuries.

Feeling-of-Knowing Paradigm. The feeling-of-knowing procedure is similar to the ACT procedure with the addition of a feeling of knowing estimation prior to recognition performance. Patients were administered 20 trigrams with delay intervals varying from 9-15 seconds. Following a failure to recall the trigram (failure is defined as at least one letter in the trigram incorrect) patients were asked to recognize the correct response from a choice of 6 trigrams. Prior to the recognition phase patients made an evaluation of their feeling of knowing from 1 (high), 2 (Medium), 3 (Low), or 4 (Pure guess). The recognition performance is compared to feeling-of-knowing estimations in order to obtain a score of prediction accuracy. Feeling-of-knowing accuracy was assessed by comparing dichotomized FOK ratings and actual recognition performance. Cell frequencies were computed and .5 added to each cell in order to avoid biasing feeling-of-knowing accuracy estimates (Agresti & Finlay, 1986). A Hules Q statistic (V = ((ad-bc/ad+bc) x.5) +.5 ; a=correct recognition and high FOK estimation, b= incorrect recognition with high FOK estimation, c=correct recognition with low FOK estimation, d=incorrect recognition with low FOK estimations; V= prediction accuracy) was obtained for each subject to represent the

relationship between estimated performance and actual recognition (possible range 0-1).

Since awareness deficits may be an inability to monitor the strength of one's memory, a measure of metamemory is included in the assessment of cognitive deficits. This procedure was reported by Blake (1973) in which he found that the feeling-of-knowing judgements were predictive of subsequent memory performance in normals. Shimamura and Squire (1986) found that feeling-of-knowing judgements of recent and remote memory were impaired for patients with Korsakoff's amnesia, and not for other amnesia patients and controls. This suggests that feeling-of-knowing inaccuracy is not an obligatory result of amnesia and since Korsakoff patients have well documented frontal impairments and the other amnesia patients do not, this suggests that feeling of knowing judgement accuracy may be dependent upon intact frontal functioning.

Denial measures

Psychological denial is the attempt to either minimize or avoid some unpleasant fact of reality. As Weinstein and Kahn (1955) pointed out in their study of brain injured patients, denial is heavily influenced by the patients premorbid tendency to deny and utilize repression as a primary defense mechanism. There is ample clinical evidence to suggest that denial increases following threat, particularly as the level

of deficits increase (Dahlstrom, Welsch & Dahlstrom, 1975; Caldwell, 1988). Watson, Plemel, Vassar, Manifold, Kucala, and Anderson (1987) conducted a validity study of several tests that were developed from the MMPI to measure denial and repression. They found two factors from the six measures which they administered with the best single measures from each factor being the Little and Fisher Denial Scale and the Welsch R-scale. Therefore the measures of denial for the current study were the Denial Scale and the R-scale (Repression Scale) from the Minnesota Multiphasic Personality Inventory-2 (MMPI-2). Evidence suggests that the R-scale and the Dn scale have both trait and state characteristics; however, denial as measured on the current questionnaires represents a fairly stable personality trait which is related to a variety of behaviors. The t-scores from the Dn scale and the R-scale were averaged for use in the analyses.

Repression scale The Repression scale (R-scale) is a 37-item scale from the Minnesota Multiphasic Personality Inventory-2, which was originally factor analytically derived from the entire item set of the MMPI (Welsh, 1956; the original scale had 40 items). The items from the MMPI-2 version are nearly identical to those of the MMPI. Three items were removed. Greene (1991) suggests that the major content areas for the R-scale are the denial of health and physical symptoms, emotionality, enjoyable social interactions, social dominance, interest in personal

appearance, and interest in personal and vocational pursuits. Items from the R-scale include questions like the following "I like mechanics magazines" (F), "I like to read newspaper articles on crime" (F), "I enjoy social gatherings just to be with people" (F), "Once in a while I feel hate toward members of my family whom I usually love" (F), "I was fond of excitement when I was young" (F), " I like repairing a door latch" (F), "Sometimes, when embarrassed, I break out in a sweat which annoys me greatly" (F), and "I have had periods in which I carried on activities without knowing later what I had been doing" (F). The item content is heterogenous and relatively non-face valid, which is consistent with the method of scale development (criterion keying) utilized for the MMPI. In addition, most of the items are assumed to be relatively unaffected by awareness deficits, given that the acquired inability to recognize deficits should not affect responses to statements such as those presented above precisely because they are not face valid and heterogenous in content. Patients with high R-scale scores are seen as unwilling to discuss their problems, reflecting the trait characteristic of denial.

The Watson et al. (1987) validity study demonstrated that the R-scale has adequate validity and can be interpreted as a measure of repression and denial. Using 190 psychiatric patients they found a correlation of .32 between the R-scale and Dn scale, suggesting that both share common variance while representing different components of denial/repression. Since

high scores require negative responses, the tendency to repress/deny pathology may be reflected in the patients tendency to negate any type of problems, including negative changes in cognitive and psychosocial status. The scale is negatively correlated with measures of anxiety (Welsch A-scale). Caldwell (1988) suggests that a high R-scale score represents an individual that is emotionally constricted across a wide spectrum of situations. Based on the new restandardization sample of the MMPI-2, the R-scale has internal consistency reliability coefficients of .69 for males and .57 for females (Greene, 1991). In addition, Hathaway and McKinley (1989) report a test-retest reliability of .77 to .79 suggesting that the scale has adequate stability. Therefore, the R-scale was used as one measure of the construct of denial for this study.

Denial scale. The Denial scale is a subset of 25 questions from the Hysteria scale (Scale 3) of the MMPI-2. Little and Fisher (1958) conducted a cluster analysis of Scale 3 from the MMPI and developed the Denial (Dn) Scale. The Dn scale can be measured on the MMPI-2 by combining three of the Harris-Lingos subscales of scale 3. These scales include the (Hy1) Denial of social anxiety, (Hy2) Need for Affection, and (Hy5) Inhibition of Aggression (Greene, 1991). Greene (1991) reports that the Dn scale shares many of it's items with the Repression-Sensitization scale (R-S; 19 items from the Dn scale are identical to those of the 26 item R-S scale), thus

many conclusions derived from analysis of this scale are applicable to the Dn scale.

There has been much research with the R-S scale. The scale items were originally devised by comparing patients responses to threatening information (T-scope presentations of threatening stimuli) with their reports on personality rating scales. Repressors were individuals that responded to the threatening information while simultaneously reporting little emotional expressiveness. Dahlstrom et al. (1975) suggested that high scorers on the R-S scale tend to "utilize techniques of stimulus suppression and denial as a means of controlling the perception of threat and any feelings of anxiety and anger" (p. 105). In addition, such individuals are described as distorting their own self-evaluations in order to feel more comfortable and block awareness of behavioral outcomes in a variety of situations. The Watson et al. (1987) study found that the Dn scale was positively related to a projective measure of repression/denial and showed the greatest validity compared to the other measures. This study demonstrated that the Dn scale has adequate validity and can be interpreted as a measure of denial and repression. Like the R-scale, many of the items from the Dn scale require negative responses, therefore high scores are likely to reflect the tendency to repress/deny any type of problems, including negative changes in cognitive status. Watson et al. (1987) also suggest that the Dn scale is a better predictor of repression/denial in a

mixed psychiatric sample than the R-S scale (despite the significant overlap) and it is strongly and positively related to a commonly used measure of defensiveness. Little and Fisher (1958) find that the correlations between the Dn scale and a measure of defensiveness, the K-scale, was .78 for general medical patients and .88 for psychiatric patients. Little and Fisher (1958) report an internal consistency reliability coefficient (Kuder-Richardson reliability coefficient) of .75 for their entire sample of 200 medical and psychiatric patients, suggesting adequate reliability for this measure. Therefore, the other measure of denial for this study was the Denial Scale from the MMPI-2.

Comparative self-knowledge measures

Patient Competency Rating Scale. The Patient Competency Rating Scale (PCRS; Prigatano, 1986b; Fordyce, 1983; Fordyce & Roueche, 1986) is a 30-item scale created for use with brain injured patients, their families, and staff members (In Appendix 2). The questions ask informants to judge the competency of the patient to carry out daily activities on a 5-point scale (1=can't do, 2=very difficult to do, 3=can do with some difficulty, 4=fairly easy to do, and 5=can do with ease). The questions tap every day activities such as activities of daily living (e.g. How much of a problem do I have in dressing myself?), instances of emotional control (How much of a problem do I have in controlling crying?), memory

(How much of a problem do I have in remembering my daily schedule?) and complex social interactions (How much of a problem do I have in participating in group activities?). Inter-staff ratings have shown high reliability (r = .92) and test-retest reliability over 1-2 weeks is reported to be substantial (Fordyce, & Roueche, 1986). Heilbronner, Millsaps, Azrin and Mittenberg (1993) evaluated the psychometric properties of the PCRS in a college population. They report an internal consistency coefficient Alpha was .90, split-half reliability was .79 and one week test-retest reliability of .82. Factor analysis revealed 6 factors which consisted of the categories of emotional control, administrative abilities, interpersonal problems, activities of daily living, personal hygiene, and memory.

The construct of comparative self-knowledge of deficits is a capacity which is frequently impaired in CHI (Prigatano, 1987). Prigatano, (1987) suggests that deficits in self-knowledge, or self-awareness deficits as it is most frequently referred to in the literature, are best measured by differences in ratings of competency between the patient and staff and family (e.g. Fordyce & Roueche, 1986). There is evidence that discrepancy measures are useful for prediction of outcome for as long as seven years after trauma (Oddy, Coughlan, Tyerman & Jenkins, 1985).

As mentioned in the literature review, the PCRS is a commonly used instrument for the assessment of competence and

awareness of deficits when compared to some standard. For example, Fordyce and Roueche (1986) studied the ratings of 28 brain injured patients, their families and staff members. The patient rated their competence the highest, followed by the patient's family, and the lowest ratings coming from the staff members of the rehabilitation team. This demonstrates that the PCRS can vary depending upon the perspective of the rater. They also found that discrepancies between staff and patient ratings on the scale differentiated three groups of patients across six months of rehabilitation and predicted treatment failure. In addition, Prigatano, Altman, and O'Brien (1990) found that patient rating on the PCRS consistently underestimated problems in emotional control and social interaction. These studies provide adequate validity for the test as a measure of competency and comparative self-knowledge.

The occupational therapist (OT; at Memorial rehabilitation) and life skill trainers (LST; at Transitions of Long Island) provided the staff ratings of the PCRS. OT's and LST's have similar training and share similar responsibilities at each facility (e.g. assisting and training patients with upper and lower body dressing, toileting, eating, grooming, and functional memory tasks). Malzer (1988) compared OT ratings of patient mobility and self-care with nurses ratings and found that OT's gave higher ratings than nurses at admission and at discharge. He suggests that this

is due to the different contexts in which the different professionals rate the patients. In addition, patient ratings of their progress during rehabilitation was highly positive and discrepant from the nurses' and therapist's ratings.

Korner-Bitensky, Mayo, and Poznanski (1990) investigated the accuracy with which occupational therapists predicted stroke patients' sensory, perceptual, cognitive, and functional recovery. Therapists rated the patients at the onset of rehabilitation and compared their ratings with post-rehabilitation ratings. Occupational therapists were very accurate in their estimation of final recovery based on intake scores. The degree of accuracy (exact pre- and post-rating agreement) ranged from 52-76% agreement, and the ratings which were not exactly accurate, were overestimations, suggesting a tendency to be optimistic about patient outcome. In addition, therapists were most accurate in their predictions of perception-cognitive outcome, and old and new therapists were equally as accurate in their judgements. This study suggests that occupational therapists are fairly accurate in predicting functional outcome for brain impaired patients. Wilson (1987) had occupational therapists rate brain impaired patients for "everyday memory problems" and divided them into groups. She found that the performance on the Rivermead Behavioral Memory Test, a test of everyday memory functioning, was significantly lower for the patients judged to be impaired in everyday memory functioning. These studies suggest that occupational

therapists are capable of making judgements of patient functional outcome and every day memory. Therefore, occupational therapists and life skill trainers completed the staff PCRS on the patients.

Scores are obtained from each scale and the discrepancy score is obtained by subtracting patient ratings from staff ratings. Scores can be positive, negative or zero, ranging from between -120 to 120. Positive scores represent self-knowledge of deficits but suggest that the patient is underestimating their ability. A score of zero represents perfect agreement between staff and patient ratings, and suggests intact comparative self-knowledge. Negative scores represent poor self-knowledge of deficits and overestimation of their functional capacity.

Self-concept/self-esteem measures

The self-concept includes descriptions of self-attributes. The self-concept is usually divided into the dimensions of social, physical, academic or occupational, and general self-respect (Blashcovich & Tomaka, 1991). As can be glimpsed from the last factor mentioned, self-concept and self-esteem are inextricably intertwined, and often measurement scales confound measurement of one with the other. Considering that available tools are not sophisticated enough to measure each separately, we shall investigate self-concept/self-esteem.

Adult General Self-Concept Inventory. Blashcovich and Tomaka (1991) reviewed several measures of self-esteem and self-concept and suggested that one of the best measures of self-concept was the Adult General Self-Concept Inventory (AGSCI). The AGSCI is a 25 item measure of multidimensional self-concept (Appendix 1). The AGSCI is the adult version of the Personal and Academic Self-Concept Inventory (PASCI; Fleming & Whalen, 1990). The PASCI is itself a revision of Fleming and Courtney's (1984) Self-Rating Scale (SRS). The SRS was originally the Feelings of Inadequacy Scale (Janis & Field, 1959). The PASCI was designed to be given to children and young adults, which is reflected in its' seven scales (Self-regard, Social Acceptance, Math Ability, Verbal Ability, Physical Appearance, Physical Ability, and Social Anxiety). The PASCI is based on Shavelson, Hubner, and Stanton's (1976) hierarchical multifaceted model of self-concept. Fleming and Whalen (1990) gave the PASCI to 222 high school students and 338 college undergraduates (Median age = 19.2). For the college sample, test-retest reliability ranged from .87 to .98 for the seven scales. Internal consistency for the scales ranged from .72 - .88. The scales demonstrated good convergent and divergent validity with measures of public and private self-consciousness, global self-esteem, and social anxiety. The Self-Regard Scale had it's highest correlation with the Rosenberg Self Esteem Scale (r = .74). Confirmatory

factor analyses demonstrated a seven factor structure, as well as a second order global self-concept factor.

The AGSCI contains the same items as the PASCI except that the academic items have been deleted, and replaced with five items which measure occupational self-concept. The occupational self-concept items were administered in this study for experimental purposes.

The AGSCI contains three subscales which are relevant to adults (physical abilities, physical appearance, and social acceptance). Given the relevance for this population, 10 items were created for this study which attempt to measure cognitive self-concept/self-esteem (in Appendix 1). Items were phrased exactly as those of the other items from the AGSCI. The validity and reliability for this subscale was assessed prior to inclusion into the study. Validity of this scale was assessed by correlation with the widely used Rosenberg Self-Esteem Scale (RSES; In Appendix 3; Rosenberg, 1979) and the other scales from the AGSCI. The RSES has been used extensively with clinical and non-clinical populations, and Newton and Johnson (1985) found that head injury patients have decreased scores on the RSES. Reliability of the cognitive self-concept/self-esteem scales was assessed by Alpha internal consistency estimates.

Therefore, the model presented was tested for three dimensions of the self-concept/self-esteem; physical, social and cognitive. Physical self-concept/self-esteem will combine

five items from the Physical Appearance factor and five items from the Physical Abilities factor. Social self-concept will contain five items from the social acceptance subscale. The cognitive self-concept/self-esteem was assessed by the 10-item scale developed for this study. All items are phrased in the form of a question, and response format is a likert scale from 1-7 (Practically Never, to Very Often). The social and physical self-concept ratings can range from 5 - 35 and the cognitive self-concept scale can range from 10 - 70.

Statistical Analyses

Validity and reliability of cognitive self-concept

All analyses were conducted using the Statistical Package for the Social Sciences-X (SPSS-X; Norusis/SPSS-X, 1990). The construct validity of the Adult General Self-Concept Inventory Cognitive self-concept/self-esteem subscale (AGSCI_CG) created for this study was assessed by correlation with the Rosenberg Self-Esteem Scale (RSES). The internal consistency of the scale was investigated using Chronbach's Alpha coefficient statistic of internal consistency. Internal consistency assesses the extent to which the individual items are consistent with one another and therefore assess a single construct.

Path analyses

All analyses were conducted using SPSS-X (Norusis/SPSS-X, 1990). The hypotheses for the experimental path model were tested by hierarchical multiple regression in order to obtain path coefficients (Pedhauzer, 1982). Before the variables were used in regression analyses, the normality of their distributions was tested with the Kolmogorov-Smirnov Goodness of Fit test (Norusis/SPSS Inc., 1990). Hierarchical multiple regression analyses utilizes multiple regression techniques to decompose the correlations between variables. Path coefficients represent the direct effect of a variable taken as a cause on a variable taken as an effect (Pedhauzer, 1982). For example, in the model, the path coefficient from cognitive deficits to self-concept/self-esteem is a partial correlation coefficient obtained by removing the effects of the other variables in the model. The path coefficient represents the expected amount of unit change in the dependent variable as a result of a unit change in the independent variable. T-tests were conducted for each of the path coefficients (beta weights) to determine if they are significantly different from chance.

In addition to testing the significance of each of the path coefficients, the goodness of fit of the entire model can be tested. This is done by comparing the overidentified model presented with a just-identified model. Overidentified models, such as the one presented, impose constraints, namely

that certain paths are zero and directional flow of paths is one way rather than bi-directional. Overidentified models have more unknown than known variables and unlike underidentified models, such as those used in factor analyses, overidentified models can be tested for significance by comparing them to a just-identified model. Just-identified models have the same number of knowns as unknowns, i.e. the number of paths proposed equals the number of possible paths. Just-identified models represent the correlation matrix between all variables in a model. Overidentified models can be compared to the just-identified model to determine whether the proposed restricted (or overidentified) model can reproduce the correlations between all of the variables.

The model presented in this study is overidentified because for each dimension of the self-concept/self-esteem investigated (i.e. cognitive, physical, and social) there is more information than is necessary to estimate the path coefficients. For the path models presented there are six knowns (the correlations among the four variables) and only three unknowns (the three path coefficients). Testing causal models is a matter of determining whether the overidentified model can reproduce the observed correlation matrix (**R**) among the variables. The null hypothesis states that the two correlation matrices are equal. If the restricted model can reproduce **R** then the model is said to be one possible model that would fit the data. The determinants of the observed and

reproduced correlation matrices can be used to compute a chi-squared with degrees of freedom equal to the number of overidentifying restrictions. This can be computed by using residual path coefficients (e; error coefficients) in the path model. A significant chi-squared leads to the rejection of the null. The null hypothesis states that there is no difference between the observed and reproduced correlations matrices; i.e. the overidentified model fits the data. So if the null is rejected it is concluded that the model does not fit the data. If the correlation matrix can be reproduced exactly, then chi-squared would be zero, which results in high p-values, which will result in a failure to reject the null, and the conclusion that the model fits the data (Pedhauzer, 1982). If the correlation matrix cannot be reproduced, then the chi-squared will approach one, the p-value will be low or significant, which will result in rejection of the null hypotheses, and the conclusion that the model does not fit the data. In order to test for the significance of the path models, Pedhauzer (1982) presents the following formula to compute the generalized squared multiple correlation for a full just-identified model:

$$R_m^2 = 1 - (1-R_1^2)(1-R_2^2)\ldots(1-R_i^2)$$
$$R_m^2 = 1 - (e_1)^2 (e_2)^2 \ldots (e_i)^2$$

This equation computes the generalized squared multiple correlation [R-squared sub m]. This represents the summary amount of explained variance explained by a fully recursive model or a just-identified model. The [R-squared sub i] is the ordinary squared multiple correlation coefficient for the ith equation for the just-identified model. As is shown, this can be replaced by the square of the residual path coefficients (e) for the just-identified model. Residual path coefficients can be obtained from the regression equations used to calculate the path coefficients.

We can calculate a statistic for the generalized squared multiple correlation of the overidentified model which is analogous to the formula presented above. This equation is presented below:

$$M = 1 - (1-R_1^2)\ (1-R_2^2) \ldots .\ (1-R_i^2)$$
$$M = 1 - (e_1)^2\ (e_2)^2 \ldots .\ (e_i)^2$$

Note that the second set of equations for M are computed in the same manner as the previous set, except that each R-squared is based upon a model that has some paths deleted, i.e. the model being tested. M represents the generalized multiple squared correlation for an overidentified model. This is the summary amount of variance that is accounted for by the model being tested. M can vary between zero and the

value of [R-squared sub m]. When an overidentified model is perfect [R-squared sub m] will equal M. A measure of goodness of fit for an overidentified model can be computed and is presented below:

$$Q = \frac{1 - R_m^2}{1 - M}$$

This equation computes, Q, a measure of the goodness of fit for the overidentified model. It represents the amount of unexplained variance (i.e. error) of a full model divided by the amount of unexplained variance of the model you are testing. Q can vary from 1 to 0 and is independent of sample size which makes it a good measure of the overall fit of the model. The more variance that the overidentified model explains, the closer the value of Q will approach one. The closer it is to one, the better the fit of the model to the data. Q will be equal to one when the full model and the model being tested have the same amount of unexplained variance. The measure of Q can be tested for significance with the following formula:

$$W = -(N - d) \log_e Q$$

N = the sample size; d = the number of overidentifying restrictions, i.e. the number of paths hypothesized to be equal to zero (3 in the models hypothesized); log-e = the natural logarithm. W has an approximate chi-squared distribution with the degree of freedom equal to the number of overidentifying restrictions (d). Note that when Q = 1 the natural logarithm of Q will be zero, and therefore the chi-square will be zero, indicating a perfect fit.

As stated previously, the null hypothesis states that correlation matrix for the model being tested is equal to the correlation matrix for the full model. A large chi-squared which is significant (i.e. it has a small p-value), leads to the rejection of the null, and it is concluded that the model does not fit the data. The larger the p-value (probability) associated with chi-squared, the better the fit of the model to the data. Therefore, if the correlation matrix could be perfectly reproduced then the chi square would be zero, and the probability value would be high and non-significant, and we would fail to reject the null.

RESULTS

Group Differences

Comparison was made between the 6 subjects from Transitions and the 51 subjects from Memorial Rehabilitation. T-test comparison of demographic and severity variables found that there were no significant differences between the groups on age (t = .17, p = .863), admitting Glasgow Coma Scale score (t = .02, p = .984), and length of coma in days (t = -.21, p = .833). There was a significant difference between the groups for years of education (t = -3.5, p = .001), with subjects from Transitions having more education than subjects from Memorial. The Transitions group also had their accidents much earlier than the memorial patients (t = - 6.86; p = .001). The Transitions patients had their accidents an average of 15 months prior to testing versus the Memorial subjects that had their accidents on average approximately 3 months prior to testing. There were no significant differences between the groups on any of the path analysis variables; cognitive deficits (t = 1.59, p = .117), denial (t = -.73, p = .466), comparative self-knowledge (t = 1.05, p = .298), cognitive self-concept (t = -.66, p = .510), social self-concept (t = .33, p = .744), and physical self-concept (t = -.12, p = .908).

When the correlation matrix for the full sample (N =57; Table 3) was compared to the correlation matrix with the Transition subjects removed (N = 51), most correlations were nearly identical whether the Transition subjects were included or not. Inspection of the correlation matrix (correlations among cognitive deficits, denial, comparative self-knowledge, cognitive self-concept/self-esteem, social self-concept/self-esteem, and physical self-concept/self-esteem variables) with the Transitions subjects removed, found three of the fifteen correlations among the variables used in the path analyses were not significant, as they had been with the full sample. The magnitude of the differences between the correlations was minimal (the differences were .05, .03, and .09). This implies that since the reduction in magnitude of the correlations was not large, reducing the number of subjects made the significance level more stringent. Comparing the regression equations for the cognitive, social and physical self-concept/self-esteem path models with and without the Transition patients; the results were nearly identical. The only difference was that, for the paths with Transitions subjects removed, the relationship between comparative self-knowledge and social self-concept/self-esteem and comparative self-knowledge and physical self-concept/self-esteem were not significant at the .01 level, but were significant at the .05 level of significance. This suggests that inclusion of the

Transitions patients did not significantly alter the results of the path analyses.

Validity and Reliability of Cognitive Self-Concept/Self-Esteem

Table 3 contains the correlation of the Cognitive Self-Concept/Self-Esteem subscale with the RSES and several other self-concept/self-esteem measures and the internal reliability of the scale. The correlation of the newly created Adult General Self-Concept Inventory Cognitive self-concept/self-esteem subscale (AGSCI_CG) with the Rosenberg Self-Esteem Scale (RSES) was in the moderate range (r = .63). This and the other correlations demonstrate that the AGSCI_CG is significantly associated with measures of global self-esteem, general self-concept, social self-concept, physical appearance and physical ability self-concept, and occupational self-concept. The AGSCI_CG was most strongly related to measures of general self-concept/self-esteem and occupational self-concept/self-esteem, as would be expected. Cognitive self-concept should be strongly related to general self-concept in the hierarchical model presented previously. Given the importance of cognitive functioning for occupational functioning, the strong correlation of cognitive self-concept/self-esteem with occupational self-concept/self-esteem is expected. In addition, it would be expected that the cognitive self-concept/self-esteem would be less strongly related to particular dimensions which do not have a strong

theoretical connection to cognitive self-concept/self-esteem. The correlations with the social, physical abilities, and physical appearance were lower, which confirms this expectation. These correlations suggest that the AGSCI_CG has adequate construct validity. The AGSCI_CG also demonstrated good internal reliability. The standardized item alpha coefficient for the 10 item subscale was in the moderate to high range (Alpha = .83). These results suggest that the subscale has adequate validity and reliability for use in the current path analysis.

Table 3

Reliability and Validity of the Adult General Self-Concept Inventory - Cognitive Self-Concept/Self-Esteem Subscale

VARIABLE	N	COGNITIVE SELF-CONCEPT/SELF-ESTEEM SUBSCALE (AGSCI_CG)
RSES	57	r = .63**
AGSCI_GN	57	r = .75**
AGSCI_SC	57	r = .41**
AGSCI_AB	57	r = .38*
AGSCI_AP	57	r = .34*
AGSCI_OC	57	r = .60**
Internal Reliability Coefficient Alpha	57	.83

* p<.01, **p<.001

(RSES= Rosenberg Self-Esteem Scale; AGSCI_GN= Adult General Self-Concept Inventory - General Self-Concept subscale; AGSCI_SC= Adult General Self-Concept Inventory - Social subscale; AGSCI_AB= Adult General Self-Concept Inventory - Physical Ability subscale; AGSCI_AP= Adult General Self-Concept Inventory -Physical Appearance subscale; AGSCI_OC= Adult General Self-Concept Inventory - Occupational subscale.)

Path Analyses

All of the variables used in the path analyses were tested for normality using the Kolmogorov-Smirnov Goodness of Fit test. Table 4 presents the mean values for all of the variables used in the path analyses, including the variables that were used to calculate the construct variables. All of the construct variables (cognitive deficits, denial, comparative self-knowledge, cognitive self-concept/self-esteem, social self-concept/self-esteem, and physical self-concept/self-esteem) were found to have distributions which were not significantly different from a standard normal distribution. Therefore, it can be assumed that these variables are adequate for use in linear regression analyses.

Table 5 presents the correlations between all of the variables that were used in the path analyses (cognitive deficits, denial, comparative self-knowledge, cognitive self-concept/self-esteem, social self-concept/self-esteem, and physical self-concept/self-esteem.) The path diagrams (as in Figure 4) which present the results of the analyses represent the variables in the form of boxes which represent the measurement model (i.e. the actual measured variables) versus circles which represent the latent constructs. The path coefficients are represented as beta weights (b).

Table 4

Mean Values for Variables used in Path Analyses

VARIABLE	N	MEAN (SD)	RANGE MIN.	MAX.
COGNITIVE DEFICITS	57	0.0 (.62)	-1.16	1.31
WCST Total Errors	57	44.7 (25.57)	6	91
TMT (B - A)	57	71.18 (66.94)	-3	293
FOK Accuracy	57	0.435 (.327)	0.00	0.947
ACT Total Correct	57	21.83 (7.37)	6	39
WMS-R DRI	57	79.40 (19.91)	50	136
DENIAL	57	52.66 (6.68)	37.83	65.0
Dn-Scale	57	49.42 (6.35)	36.67	59.33
R-Scale	57	55.90 (10.47)	34	81
CSK	57	-17.93 (16.21)	-54	29
Patient PCRS	57	126.42 (14.45)	86	150
Staff PCRS	57	108.81 (13.37)	80	135
AGSCI_CG	57	51.51 (10.98)	25	68
AGSCI_SC	57	25.40 (7.08)	10	35
AGSCI_PH	57	23.49 (5.70)	5	35

COGNITIVE DEFICITS - a z-score combination of the five cognitive deficit variables; WCST - Wisconsin Card Sorting Test; TMT - Trail Making Test; FOK -Feeling of Knowing paradigm; ACT - Auditory Consonant Trigrams; WMS-R DRI - Wechsler Memory Scale - Revised Delayed Recall Index.
DENIAL - a t-score average of the Dn-scale and the R-scale; Dn-scale - the denial scale from the MMPI-2; R-scale - the Repression scale from the MMPI-2.
CSK - Comparative Self-Knowledge calculated by subtracting staff ratings on the PCRS from patient ratings; Patient PCRS - Patient version of the Patient Competency Rating Scale; Staff PCRS - Staff version of the Patient Competency Rating Scale.
AGSCI_CG - Adult General Self-Concept Inventory Cognitive subscale; AGSCI_SC - Adult General Self-Concept Inventory Social subscale; AGSCI_PH - Adult General Self-Concept Inventory Physical subscale.

Table 5

Correlation Matrix of Variables used in Path Analyses

	1	2	3	4	5	6
1	1.00					
2	-.11	1.00				
3	.05	-.14	1.00			
4	**-.43****	-.001	**-.49****	1.00		
5	-.12	-.12	**-.32***	**.41****	1.00	
6	-.09	-.07	**-.34***	**.44****	**.58****	1.00

* p< .01, ** p< .001 (Significant correlations are highlighted)
1 = Cognitive Deficits
2 = Denial
3 = Comparative Self-Knowledge
4 = Adult General Self-Concept Inventory - Cognitive subscale
5 = Adult General Self-Concept Inventory - Social subscale
6 = Adult General Self-Concept Inventory - Physical subscale

Cognitive Self-Concept/Self-Esteem

The results of the first path analysis with cognitive self-concept/self-esteem are presented in Figure 4. This figure presents all the paths. The only significant paths are from cognitive deficits to cognitive self-concept/self-esteem and the path from comparative self-knowledge to cognitive self-concept/self-esteem. The prediction that cognitive deficits and denial were unrelated was met (r = -.11). The prediction that cognitive deficits which underlie awareness deficits should be negatively related to comparative self-knowledge was not met; the direct effect was not significant (b = .05).

The hypothesis that denial would be negatively related to comparative self-knowledge was not met. The path coefficient

was in the direction we predicted, but was not significant (b= -.14). The hypothesis that comparative self-knowledge would be negatively related to cognitive self-concept/self-esteem was met. The path diagram shows that the direct effect of comparative self-knowledge on cognitive self-concept/self-esteem was significant (b = -.49). The hypothesis that denial would not have a direct effect upon cognitive self-concept/self-esteem was met (b = -.07). The hypothesis that cognitive deficits would not have a direct effect on cognitive self-concept/self-esteem was not met. There was a significant negative path coefficient (b = -.41).

When the overidentified experimental model, as presented in Figure 1, is compared to the full just-identified model the goodness of fit suggests that the model does not fit the data (Q = .7533; W = 15.30 df = 3; p < .01). Therefore, the null hypotheses that both correlation matrices are equal was rejected.

When all of the non-significant paths are deleted and only the significant paths presented, the resulting path diagram is presented in Figure 5. The significant paths suggest that greater cognitive deficits result in lower cognitive self-concept/self-esteem. In addition, greater comparative self-knowledge leads to lowered cognitive self-concept/self-esteem. Post-hoc analysis for goodness of fit found that the restricted model did fit the data (Q = .9468; W = 2.895, df= 4; p > .50). Therefore, the null hypothesis

that this model could reproduce the correlation matrix was not rejected. Thus, the restricted model presented in Figure 5 does fit the data.

This suggests that there are dual and opposing influences upon the cognitive self-concept/self-esteem. The path from cognitive deficits suggests that more impairment results in lower ratings of cognitive self-concept; implying intact awareness of deficits. The path from comparative self-knowledge was in the opposite direction and suggests that greater discrepancies from staff are associated with higher cognitive self-concept, presumably the influence of decreased awareness.

Social Self-Concept/Self-Esteem

The results of the second path analysis model with social self-concept/self-esteem are presented in Figure 6. Only one of the paths was significant. The direct effect of comparative self-knowledge on social self-concept/self-esteem was significant (b = -.34). As mentioned previously the hypothesis that cognitive deficits would be unrelated to denial was met. Cognitive deficits and denial were both unrelated to comparative self-knowledge, the same as in the previous analysis. The paths from cognitive deficits and denial to social self-concept/self-esteem were non-significant, which is consistent with the hypotheses.

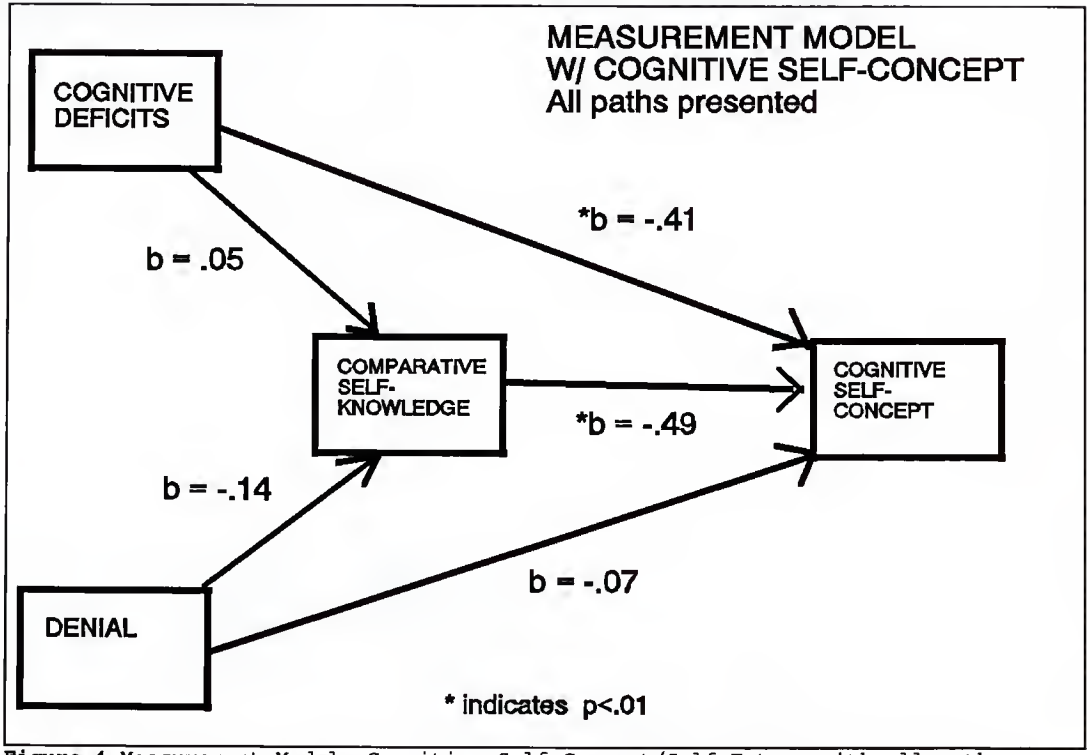


Figure 4 Measurement Model: Cognitive Self-Concept/Self-Esteem with all paths.

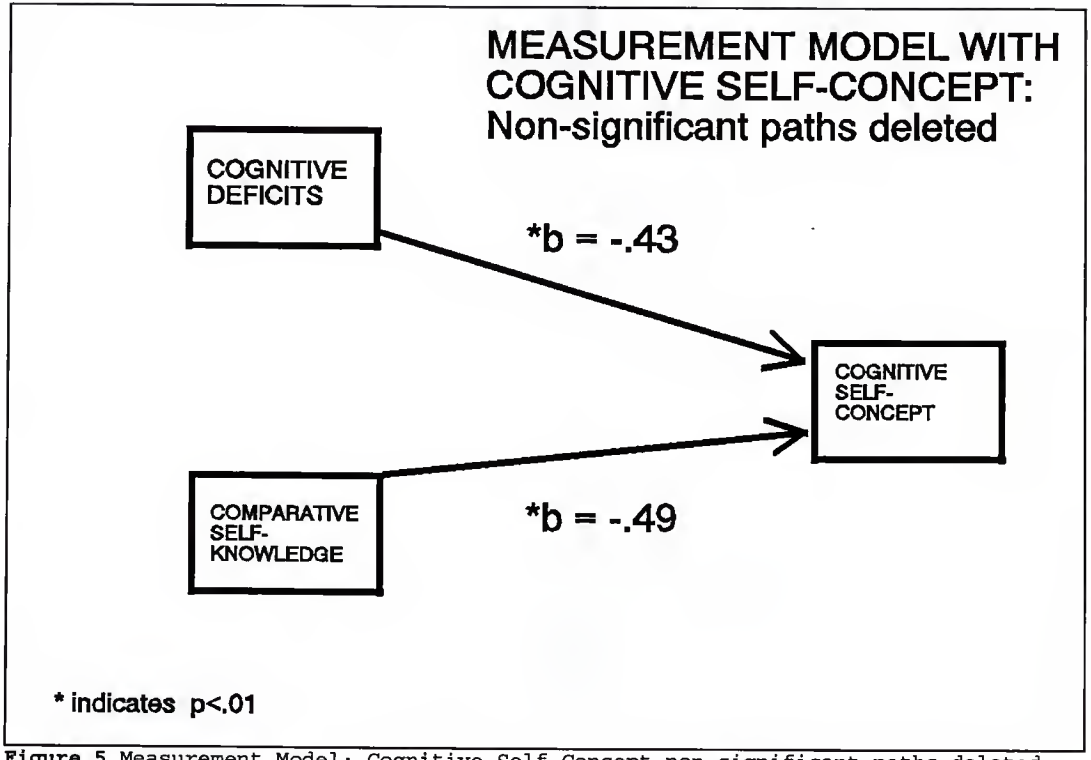


Figure 5 Measurement Model: Cognitive Self-Concept non-significant paths deleted

When the overidentified experimental model, as in Figure 1, is compared to the full just-identified model, the goodness of fit analysis suggests that this model does fit the data (Q = .9425; W = 3.198 df= 3 p >.30). The null hypothesis that the correlation matrices were equal was not rejected, despite several insignificant paths. The model could not be rejected as a poor fit because the only path that was significant was included in the experimental model.

When all of the non-significant paths are deleted, with only the significant paths, the resulting path diagram is presented in Figure 7. This model suggests that greater comparative self-knowledge leads to lowered social self-concept/self-esteem. Post-hoc analysis for goodness of fit found that the restricted model also fit the data (Q = .9226; W = 4.189, df= 5; p > .50). Therefore, the null hypothesis that this model could reproduce the correlation matrix was not rejected and it can be concluded that this is one model which fit the data. The second model is preferred to the former for reasons of parsimony.

Physical Self-Concept/Self-Esteem

The third model with physical self-concept/self-esteem is presented in Figure 8. Only one of the paths was significant. The direct effect of comparative self-knowledge on physical self-concept/self-esteem was significant (b = -.35). As mentioned previously the hypothesis that cognitive deficits

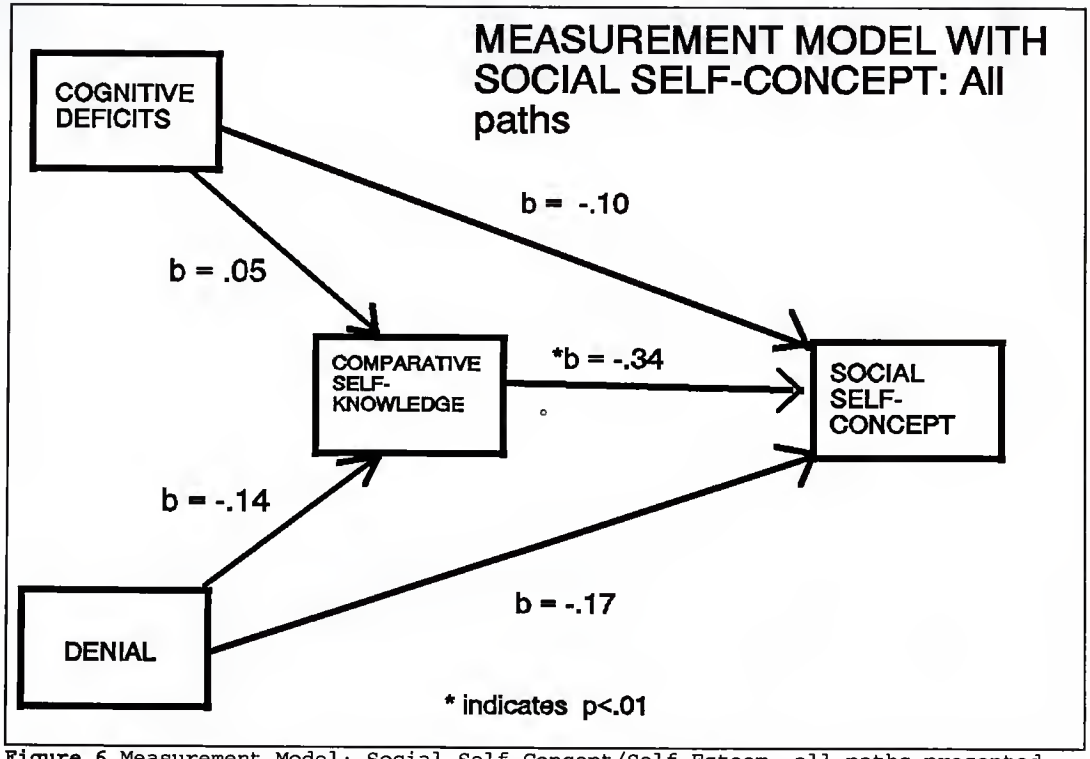


Figure 6 Measurement Model: Social Self-Concept/Self-Esteem, all paths presented

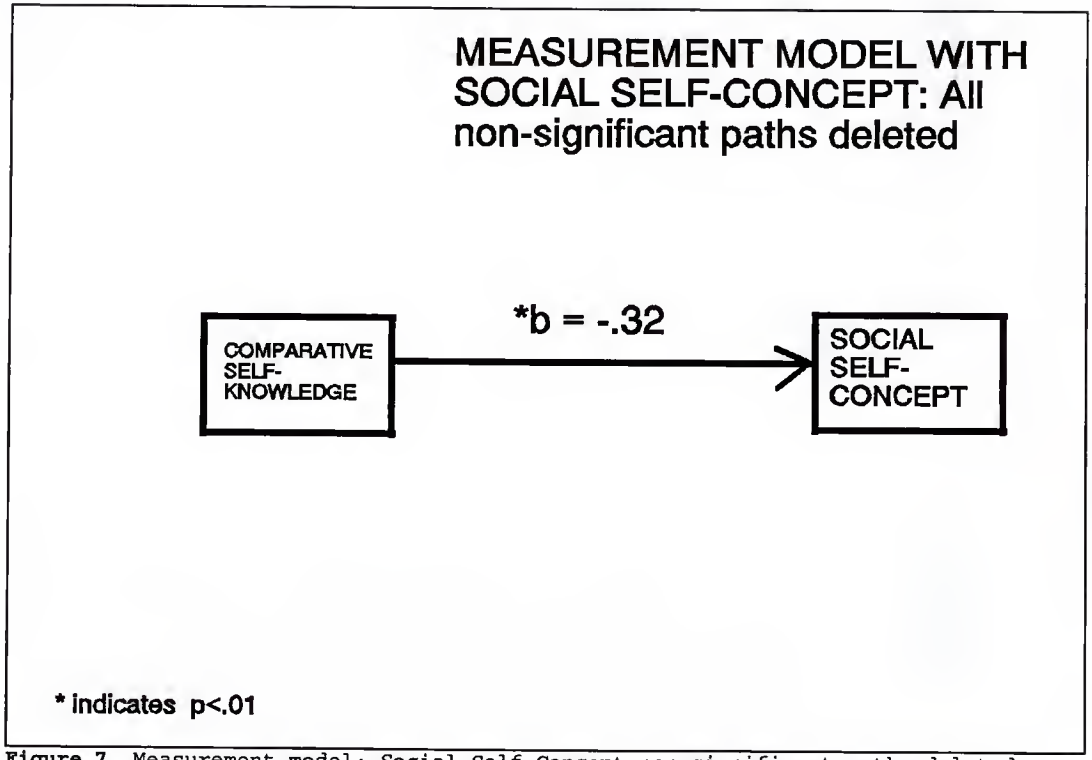


Figure 7 Measurement model: Social Self-Concept non-significant paths deleted

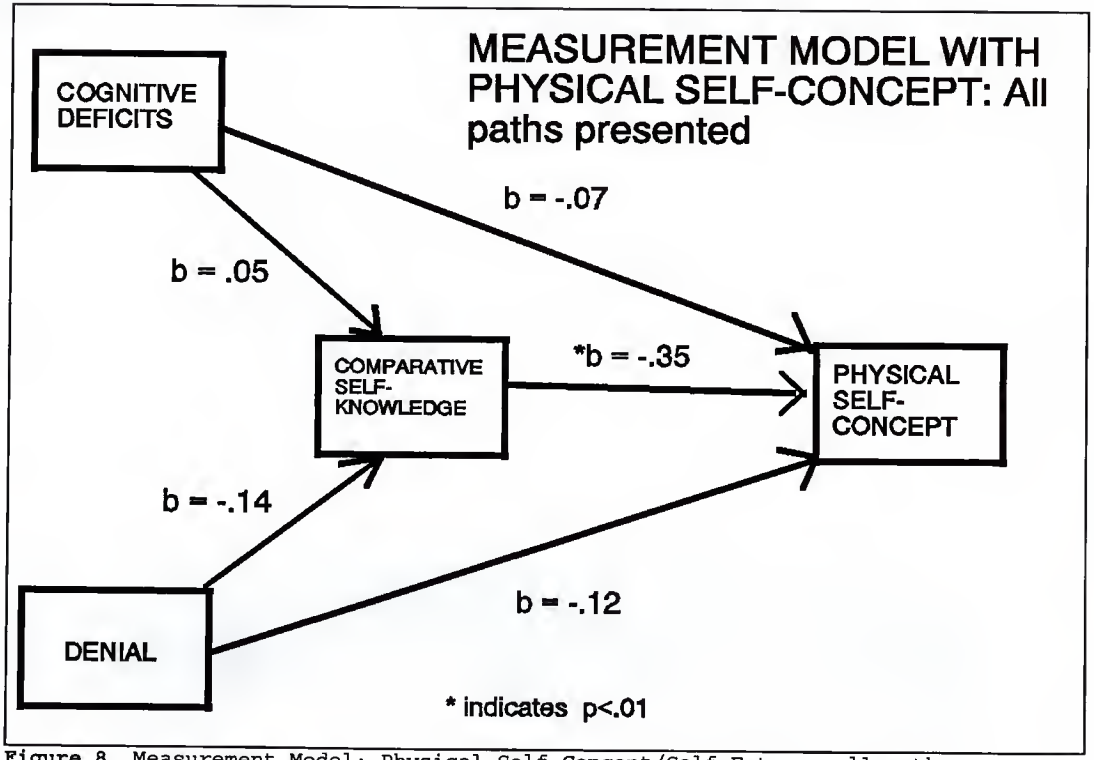


Figure 8 Measurement Model: Physical Self-Concept/Self-Esteem, all paths

would be unrelated to denial was met. Cognitive deficits and denial were both unrelated to comparative self-knowledge, the same as in the previous analyses. The paths from cognitive deficits and denial to physical self-concept/self-esteem were non-significant, which is consistent with the hypotheses.

When the overidentified experimental model, as in Figure 1, is compared to the full just-identified model the goodness of fit analyses suggest that this model does fit the data (Q = .9700; W = 1.665 df= 3 p >.50). The null hypothesis that the correlation matrices were equal was not rejected, despite several insignificant paths. The model could not be rejected as a poor fit because the only path that was significant was included in the experimental model.

When all of the non-significant paths are deleted, with only the significant paths included. the resulting path diagram is presented in Figure 9. This model suggests that greater comparative self-knowledge leads to lowered physical self-concept/self-esteem. Post-hoc analysis for goodness of fit found that the restricted model also fit the data (Q = .9495; W = 2.697, df= 5; p > .70). Therefore, the null hypothesis that this model could reproduce the correlation matrix was not rejected and this is one possible model that fits the data. As with the social self-concept/self-esteem model, the restricted model is preferred to the former full model because of parsimony.

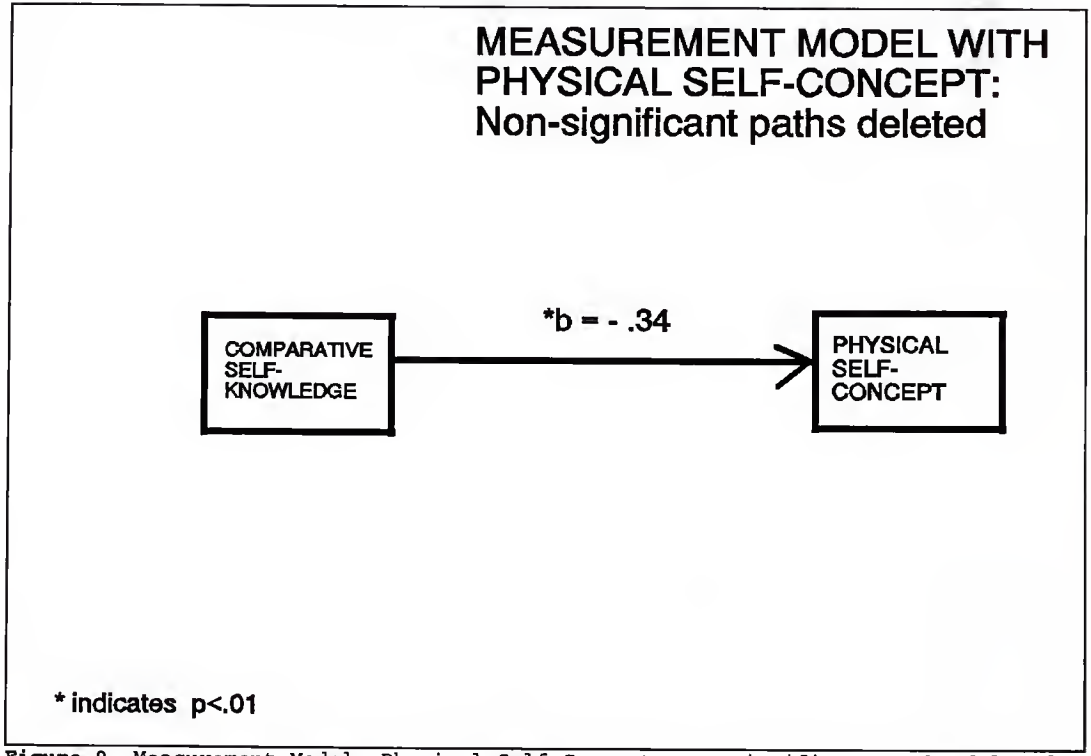


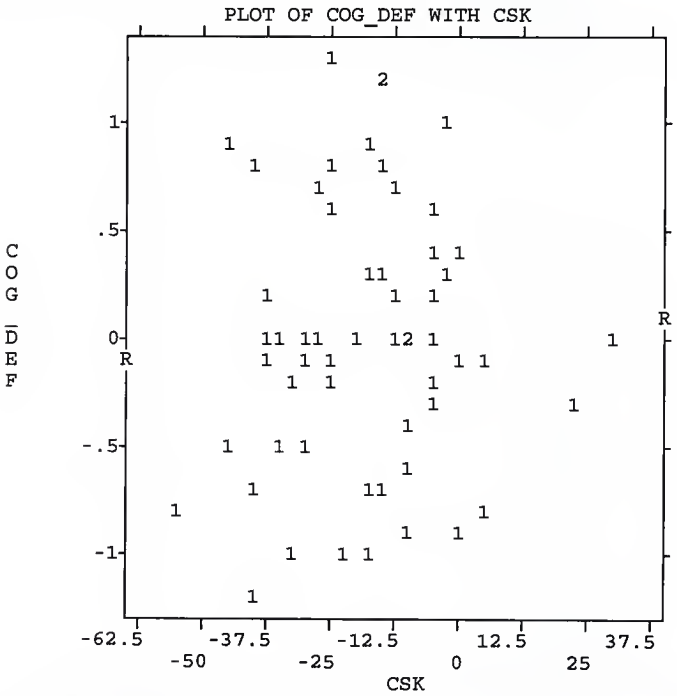
Figure 9 Measurement Model: Physical Self-Concept, non-significant paths deleted

Post-hoc Analyses

The relationship between cognitive deficits and comparative self-knowledge in all the models was not significant. However, it may not have been significant because analysis of the scatterplot (see Figure 10) for the two variables suggested that the relationship was possibly curvilinear. If this were in fact true, then the relationship that existed was that at the highest and lowest levels of cognitive impairment, comparative self-knowledge was low, and the middle level of cognitive impairment was associated with greater comparative self-knowledge. Attempts were made to linearize the cognitive deficit variable by adding a quadratic function to the regression of cognitive deficits on comparative self-knowledge by squaring the cognitive deficit variable and adding it to the regression equation (Cohen & Cohen, 1983). The multiple correlation (R = .19; F = .978, p = .383) was greater than the simple correlation, suggesting a greater fit, but was not significant. This suggests that there was no consistent significant relationship between these variables.

Figure 10

Scatterplot of Cognitive Deficits with Comparative Self-Knowledge



Another possible reason why cognitive deficits and denial were unrelated to comparative self-knowledge could have been the result of averaging many scales to form these variables. This may have created noise and obscured stronger individual

relationships. Further analyses were conducted to determine whether any of the individual scales were predictive of comparative self-knowledge.

Stepwise regression analysis was conducted with the cognitive deficits scales (TMT, WCST, FOK, ACT, WMS-R) to determine which variables best predicted comparative self-knowledge. No variables were entered into the forward stepwise regression analyses because none of scales predicted a significant amount of variance. When the variables were forced into the equation the resulting multiple correlation (R= .20; F= .413, p= .838) was stronger than the relationship between cognitive deficits and comparative self-knowledge alone, but it was still not significant. The correlations and beta weights for each of the scales are presented Table 6. The individual correlations and beta weights for the cognitive deficit scales were not significant predictors of comparative self-knowledge. Interestingly, the correlations and beta weights for the WCST and the ACT were negatively related to comparative self-knowledge while the Trail Making Test, Feeling-of-Knowing, and the Delayed recall index from the WMS-R were positively related. This suggests that the scales may have been opposing one another in their prediction of comparative self-knowledge, which may have weakened the relationship further.

Table 6

Correlations and Beta Weights for the Cognitive Deficit Scales and the MMPI-2 Denial Scales with Comparative Self-Knowledge

Variables	N	Comparative Self-Knowledge r	b
COGNITIVE DEFICIT SCALES			
WCST Total Errors	57	-.03	-.13
TMT (B - A)	57	.10	.13
FOK Accuracy	57	.08	.08
ACT Total Correct	57	-.05	-.13
WMS-R DRI	57	.07	.14
DENIAL SCALES			
Dn-Scale	57	-.08	-.06
R-Scale	57	-.13	-.12

* .01, ** .001

Note: the cognitive deficit scales have been reversed so that higher values represent more impairment.
(WCST - Wisconsin Card Sorting Test; TMT - Trail Making Test; FOK Accuracy - Feeling-of-Knowing paradigm; ACT - Auditory Consonant Trigrams; WMS-R DRI - Wechsler Memory Scale - Revised Delayed Recall Index; Dn-Scale - the Denial scale from the MMPI-2; R-Scale - the Repression scale from the MMPI-2; Comparative Self-Knowledge calculated by subtracting staff ratings on the Patient Competency Rating Scale from the patient ratings)

As an exploratory analysis, stepwise regression was performed on several cognitive variables, which were available for a subset of the larger sample, in order to predict comparative self-knowledge. Several cognitive scales, which included the Wechsler Adult Intelligence Scale - Revised (WAIS-R; Wechsler, 1981), Controlled Oral Word Association Test (COWAT; Spreen & Benton, 1977), and the Wisconsin Card Sorting Test - Perseverative errors (Heaton, 1981) were administered to 49 of the total 57 subjects. The Verbal IQ (VIQ) assesses overall verbal intellectual abilities, the

Performance IQ (PIQ) assesses visuoperceptual/non-verbal abilities and motor speed, and the Full Scale IQ (FSIQ) is a composite of these scales and assesses overall cognitive functioning. Anderson and Tranel (1989) found that Verbal IQ was significantly related to the degree of unawareness patients demonstrated during an "awareness interview." The COWAT assesses verbal phonemic productivity and is considered to be sensitive to frontal lobe lesions (Lezak, 1983). Recent studies by Starkstein (1993) and Coben, Boksenbaum & Kulberg, (1994) found that patients with more unawareness had decreased verbal productivity on a COWAT. Perseverative errors from the WCST assesses executive self-monitoring, which is a component of the total errors variable used in the study. When these variables were entered into a stepwise regression to predict comparative self-knowledge, the only variable to enter the equation was Full Scale IQ. The beta weight coefficient was significant (b= .32; p < .05) and was positive. This suggested that higher post-injury IQ scores, are related to greater comparative self-knowledge. It also suggests that FSIQ may be related to awareness deficits, because the greater the FSIQ score, the greater the level of self-knowledge. So the more cognitive deficits they demonstrate on this scale, the lower the patients self-knowledge.

Stepwise regression was conducted with the scales used to measure denial to determine which scale best predicted comparative self-knowledge. Neither of the MMPI-2 scales

entered into the forward stepwise regression equation because they did not predict a significant amount of variance. When the two scales were forced into the equation, the resulting multiple correlation (R= .14; F= .54, p= .58) was not significant, and no different from the simple correlation between the composite denial score and comparative self-knowledge. The individual correlations and the beta weights are presented in Table 6. Neither of the scales were significantly related to comparative self-knowledge.

The Dn-scale and the R-scale also were not significantly related to the different dimensions of the self-concept. The correlation between the cognitive self-concept/self-esteem and the Dn-scale was r= .23 (p >.01), and the R-scale was r= -.14 (p > .01); both of which were non-significant. The correlation between the social self-concept/self-esteem and the Dn-scale was r= .04 (p > .01), and the R-scale was r= -.18 (p > .01); both of which were non-significant. The correlation between the physical self-concept/self-esteem and the Dn-scale was r= .05 (p > .01), and the R-scale was r= -.12 (p > .01); both of which were non-significant. This suggests that the denial measures were not differentially related to the self-concept.

DISCUSSION

The purpose of this study was to understand how awareness of deficits is related to various components of the self-concept among severe closed head injury patients. Based on a review of the literature concerning awareness, self-concept, and psychological distress among head injury patients, a path model was proposed which attempted to incorporate the relationships that exist among these variables. A portion of this wider path model was tested for this study. This path model (Figure 1) hypothesized that certain cognitive deficits underlie awareness deficits; therefore, cognitive deficits would lead to reduced self-knowledge (i.e. cognitive functioning would be negatively related to comparative self-knowledge). The model also predicted that denial would be negatively related to comparative self-knowledge. In addition, comparative self-knowledge would have a direct effect and be negatively related to self-concept/self-esteem.

Major Findings

When analyses were conducted for the cognitive, social, and physical self-concept/self-esteem, the one prediction that was consistently supported was that comparative self-knowledge was negatively related to each of the dimensions of self-

concept/self-esteem. This suggests that the more self-knowledge that patients possess concerning their deficits, the lower their self-concept/self-esteem about their cognitive, social and physical functioning. Therefore, the more they know about the changes they have undergone the more their self-descriptions and self-evaluations reflect these changes. In the introduction, there were three motives ascribed to the self-concept: self-enhancement, self-consistency, and meeting the demands of reality which explain the dynamic functioning of the self-concept (Epstein, 1987). The finding that the level of self-knowledge results in changes in self-concept is consistent with this framework. If self-knowledge increases, then we can assume that the demands of reality were mediating the decrease in self-concept. However, if self-knowledge is low then the motives of self-consistency and self-enhancement are active, because the self-concept tends to be high.

The prediction that denial and cognitive deficits would be unrelated was supported. However, the prediction that several neuropsychological variables which were thought to underlie awareness deficits would be negatively related to comparative self-knowledge was not supported. There was a possibility that they were related, but in a curvilinear manner; however, attempts to correct for a non-linear relationship did not add appreciably to the correlation with comparative self-knowledge. The prediction that denial would be negatively related to comparative self-knowledge was also

not supported. The direct effect of denial on comparative self-knowledge was in the predicted direction but not statistically significant (b = -.14). In addition, neither scale predicted a significant amount of variance. For all the different dimensions of the self-concept examined, denial was not significantly related to any variables. The results for the path models for the different dimensions of the self-concept/self-esteem were similar with the exception of the cognitive self-concept/self-esteem model.

The results for the cognitive self-concept/self-esteem model were different because cognitive deficits were related to cognitive self-concept/self-esteem. While the cognitive deficits variable was unrelated to comparative self-knowledge, it had a direct effect upon cognitive self-concept/self-esteem. This latter finding was interesting for two reasons. The first was that we had predicted that it would have an effect through comparative self-knowledge and the second was that the direction of the relationship was positive which suggested that increased cognitive impairments results in lower cognitive self-concept/self-esteem. If, as postulated, the combination of cognitive deficits chosen (alternating attention, working memory, memory, self-monitoring, abstract reasoning, and metamemory) were directly influencing neurologically mediated awareness deficits, then this finding was odd. It suggests that the more a patient was incapable of being aware of the changes they had undergone, the lower their

self-concept about their cognitive functioning. This conclusion is counter-intuitive, because logic would predict that increased awareness deficits would result in a failure to change their self-concept, and therefore, result in higher self-concept ratings. This suggests that the cognitive deficit measure was not indirectly assessing awareness deficits and was only assessing cognitive deficits. Confirmation of this finding is supported by a study by Lynch (1989) conducted on mild head injury patients. Lynch (1989) also found that increased cognitive deficits were related, although weakly, to lower self-esteem. Increased impairment in cognitive functioning was also associated with higher self-consciousness, suggesting that it was related to increased awareness.

The resulting path model for cognitive self-concept/self-esteem, as presented in Figure 6, suggests two influences upon cognitive self-concept/self-esteem. If it is assumed that cognitive deficits were not indirectly assessing awareness deficits, then the influence of cognitive deficits suggests that the more cognitive impairments that patients experience the more their cognitive self-concept/self-esteem suffered. To a large extent, this influence suggests preserved awareness of deficits because the more impairment they demonstrated on neuropsychological tests the more it was reflected in their self-concept, consistent with the self-concept motive which accommodates the demands of reality. The second influence on

cognitive self-concept/self-esteem suggests that decreased self-knowledge leads to higher self-concept/self-esteem ratings. Stated differently, the more patients know they have deficits on a variety of practical tasks the lower their cognitive self-concept. Taken together with the influence of cognitive deficits, this suggests possible opposing influences of awareness and cognitive deficits upon cognitive self-concept/self-esteem. The data suggest that the patient's perception of their cognitive functioning, i.e. their cognitive self-concept, is influenced by cognitive deficits and the level of awareness of their deficits; this reflects, both accommodations with the reality of their impaired cognitive functioning as well as the tendency to enhance the self-concept and/or maintain it at current levels (i.e. self-enhancement and self-consistency motives). These influences can work in concert to raise or lower cognitive self-concept/self-esteem or they can oppose each other to result in middle levels of cognitive self-concept/self-esteem. For example, we would predict, based on the data, that a person with high cognitive impairments and high self-knowledge would have low cognitive self-concept. Someone who had low cognitive deficits and low self-knowledge would likely have high cognitive self-concept. If cognitive deficits are low and self-knowledge high or cognitive deficits high and self-knowledge low, this would likely result in an opposing influence on their cognitive self-concept and mid-levels of

cognitive self-concept. While one influence is having the effect of lowering cognitive self-concept/self-esteem the other influence is raising it or at least not having a detrimental effect upon the cognitive self-concept.

This state of affairs is encouraging because it implies that many patients are at least to some degree aware of the changes they have undergone. This conclusion is supported by the Allen and Ruff (1989) study which found that patients with severe head injury lose the normal tendency to say that their cognitive functions were "strengths" and only state that they had "no problem" with their cognitive functions. The patients found a middle ground in which they admit to having undergone some changes in cognitive functioning, but this did not mean they had a "weakness", which would be consistent with the dual opposing influences upon the cognitive self-concept ratings found in the present study.

This conclusion, is supported by some additional analyses related to patient premorbid self-esteem and present self-esteem ratings on the Rosenberg Self-Esteem Scale (RSES). The results of the Allen and Ruff (1989) study suggest that, as a group, the expected mean change in current self-concept, relative to premorbid self-concept/self-esteem, would be a small downward estimation. In addition to the scales used in the study, all patients were administered the RSES (scores range from 10 - 60) and asked to rate it for their present and premorbid perception of themselves. The premorbid and current

ratings were significantly correlated, ($r(56) = .75, p < .001$), and the present ratings were significantly lower than premorbid self-esteem ratings ($t(56) = -3.37$, $p = .001$.) The average difference between premorbid and present self-esteem ratings was -2.82.

Another interesting aspect of the finding that cognitive deficits influences cognitive self-concept was its specificity. Cognitive deficits had a direct effect upon cognitive self-concept/self-esteem, but did not have this direct effect on the social or physical self-concept/self-esteem. One potential explanation for this specific finding is that the patients were confronted with their cognitive deficits as a routine part of their rehabilitation. This is consistent with the Fordyce and Roueche (1986) study which found that a subgroup of their patients demonstrated improvement in awareness following six months of treatment. In addition, in most cases the patients in this study underwent extensive neuropsychological testing before they completed the self-concept questionnaires, which would at least give them a better opportunity to observe their cognitive weaknesses directly. In addition, the specificity may have been due to the fact that treatment did not emphasize awareness of their social functioning or how their physical deficits would influence daily activities. The effect of treatment may have had an impact on their level of intellectual awareness of their cognitive deficits which

resulted in direct change of their cognitive self-concept, but not their social or physical self-concept.

As just stated, cognitive deficits were negatively related to cognitive self-concept/self-esteem. What, if any, relevance does this have for the relationship between cognitive deficits and comparative self-knowledge? We hypothesized in the wider model (Figure 2) that cognitive deficits would have a direct influence upon awareness deficits (which we did not directly measure) which would then have a direct influence upon comparative self-knowledge. We did not find a significant relationship between cognitive deficits and comparative self-knowledge. Either we failed to find measures which adequately predict awareness deficits, and as a result find that cognitive deficits lack predictive power; or the scales we chose to measure cognitive deficits were related to awareness deficits, but our hypothesis that awareness deficits influence comparative self-knowledge was proven incorrect. In other words, did we choose weak indirect measures of awareness deficits, or was our hypothesis about awareness deficits incorrect? The former explanation, that we chose poor measures, appears to have greater support precisely because the cognitive deficit variable was negatively related to cognitive self-concept. If the cognitive deficit scales we chose to measure awareness deficits were indirectly measuring awareness deficits, then we would not expect it to be negatively related to cognitive self-concept. As stated

above, this would be counter-intuitive, because we would expect increased awareness deficits to cause inflation and/or maintenance of cognitive self-concept and not cause it to decline. If, on the other hand, we assume that we chose measures which were unrelated to awareness deficits, then it seems reasonable to suppose that cognitive impairments have a negative effect upon cognitive self-concept (Lynch, 1989). So we are left with the assumption that our cognitive deficit variable is simply measuring cognitive deficits. Therefore, regarding the relationship between cognitive deficits and comparative self-knowledge, we would not expect cognitive deficits to be related to comparative self-knowledge. Support for this conclusion can be found in studies by McKinley and Brooks (1984) and Prigatano (1991). Both studies failed to find relationships between several measures of cognitive deficits and unawareness scores (which are similar to comparative self-knowledge scores used in this study).

The results for social and physical self-concept/self-esteem were similar to one another. Comparative self-knowledge had a significant direct effect on both social and physical self-concept/self-esteem. Increased comparative self-knowledge of deficits results in lower self-concept/self-esteem ratings. This suggests that increased awareness of deficits has a negative impact on the patient's perception of their social functioning and physical appearance and physical abilities. This is consistent with the literature reviewed,

which suggests that the physical and social self-concept of patients are affected following the injury, and that their perceptions are influenced by their level of awareness. Tyerman and Humphrey (1984) found that about a third of their sample of patients with severe head injury, were self-conscious and felt socially uncomfortable about their physical disabilities. This suggests that the social and physical self-concept are related, to the extent that patients feel uncomfortable in social settings because of their physical deficits. They also reported that as a group, the head injury patients' current self-concept suffered relative to their ratings for pre-injury self-concept, but they confidently expected to return to premorbid levels in the future. In addition, they saw their self-concepts as better off than a typical head injury patient. The authors suggested that this lack of insight may have accounted for those that did not report being uncomfortable about their physical symptoms. Newton and Johnson (1985) found that compared to a non-clinical population, and outpatient psychotherapy patients, patients with severe head injury demonstrated impaired social skills during a videotaped assessment of their social interactions, and had poor social adjustment as rated by a relative. However, the head injury patients reported less social anxiety than the psychotherapy patients. The head injury patients also rated their self-esteem as higher than the psychotherapy patients, but reported lower self-esteem

than the non-clinical population, as rated on the RSES. Newton and Johnson (1985) suggested that decreased awareness may have accounted for the discrepancy between the head injury patients low ratings of social anxiety while demonstrating poor social skills and social adjustment, in addition to their higher ratings of self-esteem than the psychotherapy patients. As previously mentioned, cognitive deficits were related to cognitive self-concept/self-esteem but not social and physical self-concept/self-esteem. Perhaps if measures of actual social and physical deficits were administered in this study, similar to cognitive deficits, they would be related to social and physical self-concept/self-esteem, respectively.

Next, we must consider why denial was unrelated to comparative self-knowledge. One possible explanation is that the general measures of denial chosen for this study do not apply specifically to whether or not a patient is denying lost function after a head injury. It may also be that the scales were adequate, but denial does not play that great a role influencing self-knowledge and self-concept.

So far, I have mentioned possible explanations for why cognitive deficits and denial were unrelated to comparative self-knowledge. The literature review suggests that both variables should influence the patients level of self-knowledge (e.g. Fordyce & Roueche, 1986; Prigatano, Altman & O'Brien, 1990; Rubens & Garrett, 1991; Schacter, 1991; Deaton, 1986). In the absence of alternative explanations we must

revise our model. One alternative explanation mentioned above, is that the measures chosen were not adequately assessing the constructs of interest (cognitive deficits underlying awareness deficits and denial).

The choice of measures to assess cognitive deficits was based primarily on theory, and there is currently no empirically supported theory regarding the neuropsychological mechanisms that cause unawareness. Several other studies failed to find consistent relationships between neuropsychological variables and different measures of unawareness (e.g. Anderson & Tranel, 1989; McKinley & Brooks, 1984; Prigatano, 1991). However, there is recent evidence which suggests several promising neuropsychological variables which can predict unawareness. Coben, Boksenbaum & Kulberg, (1994) set out to assess the neuropsychological variables which would predict unawareness. They administered several neuropsychological tests and questionnaires to 22 brain damaged patients undergoing rehabilitation. Patients were administered several measures of executive functioning (the Symbol Digit Modalities Test, Controlled Oral Word Association Test- FAS, Ruff Figural Fluency Test, Behavioral Dyscontrol Scale, Wisconsin Card Sorting Test, a Cognitive Estimation Test and the Tower of Hanoi). They also had patients and therapists complete an "Awareness of Deficits Questionnaire" which asked for ratings on the their motor, sensory, cognitive, and interpersonal/emotional functions. Patient

scores were compared to therapist scores in order to obtain an unawareness score (nearly identical to our score for comparative self-knowledge). They found that the best predictors of unawareness were the Cognitive Estimation Test and the Controlled Oral Word Association Test, accounting for 50% of the variance in unawareness scores. The Cognitive Estimation Test may have been tapping the ability of patients to form an "abstract attitude" (Lezak, 1987b) which is thought to be a function of the frontal lobes (Stuss & Benson, 1986). This study is encouraging because it suggests that there are cognitive deficit variables which predict comparative self-knowledge. It also suggests that there are cognitive deficits which are and are not related to awareness deficits. However, the measures which were significant predictors in the Coben et al. (1994) study were not strongly represented in the cognitive deficit variable from the current study, and we did not find a significant relationship between the COWAT and comparative self-knowledge in the post-hoc regression analyses. Therefore, in the future we may want to emphasize measures of frontal mediated executive deficits in our composite of cognitive deficits.

Another possible cognitive measure that may be related to comparative self-knowledge is Full scale IQ. In a post-hoc analysis, Full Scale IQ was a significant predictor of comparative self-knowledge. However, the reason for this is unclear. If we assume that some of the variance of post-

injury IQ is accounted for by premorbid IQ, then this would suggest that the more intelligent the patient is, the more self-knowledge they posses. It could also be that lower IQ patients had some difficulty interpreting the questionnaires. This is supported by Gasquoine (1992) who found that patients' knowledge of different cognitive terms (attention, memory, planning, etc.) was associated with the discrepancy between their ratings and the therapists ratings. This suggests that if they do not understand the terms well, they are more likely to be discrepant from staff ratings of their abilities. On the other hand if the FSIQ is interpreted as a measure of current global cognitive functioning, then it would suggest that it is assessing, in part, awareness deficits, because the direction of the relationship suggested that greater impairments were related to less self-knowledge. Clearly, more research needs to be done to find the cognitive deficits which predict comparative self-knowledge. So rather than revise our theory about the relationship between cognitive deficits, awareness deficits, and comparative self-knowledge, it would more prudent to go about empirically validating the best measures of the construct in which we are interested.

A similar question about the adequacy of the measurement instruments could be raised about denial. If the current instruments used to assess denial were adequate then it would suggest that denial does not influence the patients self-knowledge or self-concept. As previously mentioned denial was

not significantly related to any of the constructs in the study. However, there was some suggestion that it was weakly related to comparative self-knowledge. It is possible that the two measures of denial used in the current study were differentially assessing the construct. Analysis of the individual relationships between the Dn-scale and R-scale with comparative self-knowledge suggests that they were not differentially assessing comparative self-knowledge. In addition, the two scales did not have significant relationships to all the dimensions of the self-concept/self-esteem. More validity research needs to be conducted to compare the relative value of these denial scales.

As mentioned above, we found a consistent relationship between comparative self-knowledge and the different dimensions of the self-concept/self-esteem, as predicted. The explanation we gave for this was that discrepancy between staff and patient ratings on the PCRS was a measure of the self-knowledge of the patient, and that the more self-knowledge they demonstrate, the lower would be their self-concept. One alternative way of conceptualizing this relationship and perhaps an implication of our findings, is that agreeing with the therapist is costly to patients' self-esteem. To the extent that these variables were related in our study, disagreement with therapists would appear to impart a benefit for their self-esteem. This may explain why patients are rating themselves as more competent than the

therapist is rating them. There is probably some implicit and explicit pressure on the patients to align their assessment of their functioning with that of the their therapists; however, the cost to self-esteem may be too high to pay. This may also explain why many patients think that their only problem is the therapist constantly finding fault with them.

In other studies, occupational therapists, however, are fairly accurate in their assessment of patient functioning, and there is a suggestion that they are biased toward over-estimating patient competence (Korner-Bitensky, Mayo & Poznanski, 1990; Malzer, 1988). These findings suggest that patient-therapist discrepancies in the current study are a reflection of patient inaccuracies. Indeed, patients disagreed with therapists (only 6/57 subjects had PCRS scores which matched or were below the therapist PCRS ratings) who are probably biased to overestimate their performance relative to other rehabilitation professionals.

One interesting suggestion Malzer (1990) made regarding why OT ratings were higher than nurses ratings in their study was that patients are willing to express more of their dependency needs to a nurse, but when they go to "therapy" there is an implicit demand that they perform to the best of their abilities. The therapist therefore sees the patient at their best. This may also help explain why patient ratings for skills on which they primarily work with their occupational therapist, were high, relative to their OT's

ratings. In effect, the tendency to do their best with their OT's may have translated into reporting their best as well.

In summary, the current study provided confirming evidence that the level of comparative self-knowledge has a direct effect on patients' cognitive, social, and physical self-concept. However, cognitive deficits and denial did not have significant effects on the level of comparative self-knowledge, which were major assumptions of our model. Nonetheless, before we revise our model, construct validity related issues need to be addressed. There is some evidence that the measures chosen to assess cognitive deficits and denial may not have been ideal. The current study also found that there were dual/opposing influences on the cognitive self-concept/self-esteem. The influence of cognitive deficits suggests that at least some patients have preserved awareness of their deficits which conforms to the demands of reality. On the other hand, the influence of comparative self-knowledge suggests that those patients who demonstrate lower comparative self-knowledge are able to maintain higher levels of self-esteem.

Limitations and Future Directions

There are several limitations of the current study. The number of subjects was relatively small and precluded the inclusion of the other variables from the wider model. In addition, more subjects would have provided greater

statistical power with which to find significant relationships. If there had been a greater number of subjects certain paths may have been significant, although the strength of the relationship would theoretically have remained the same. In addition, if there were more subjects, then statistical methods such as Structural Equation Modeling could have been used which would have had the advantage of relating error free measurement of the constructs. Another limitation was that instruments chosen to measure the latent constructs were imperfect. As already mentioned above, more construct related research needs to be done in this area. In addition, the strength of the relationships was not overwhelming. The strongest relationship accounted for approximately 25% of the variance which leaves a majority of the variance yet to be explained. While the subject sample was homogeneous with respect to severity of injury, the study may have benefitted from including subjects with a greater range of severity to test the generalizability of the model for moderate and mild head injury patients. Based on the Allen and Ruff (1990) study we would expect that mild head injury patients would show very little unawareness and would provide a greater range of comparative self-knowledge scores. Since the research literature suggests that awareness may change with time (Fahy, Irving & Millac, 1967) and over the course of treatment (Fordyce & Roueche, 1986), the study may have benefitted from inclusion of subjects at different stages of their recovery.

Another important limitation refers to the patients premorbid status. For instance, we do not currently know how aware these patients were before their injuries, nor do we know the level of their self-esteem or their level of their cognitive functioning prior to the injury. As mentioned in the review, non-head injured people can vary in the level of awareness they demonstrate, and they may vary in their awareness for different cognitive functions and different abilities (Allen & Ruff, 1990; Goldberg & Barr, 1991). In addition, patients may have had high or low self-esteem premorbidly which would affect their current ratings. We also could not account for premorbid levels of cognitive functioning. A patient that had above average intelligence before the accident may consider average performance on cognitive tests as being an impairment. Our cognitive deficit variable did not account for premorbid ability levels. Many of the limitations of the current study stem from the preliminary nature of these analyses and the early stage of development of this field of investigation. Previously, studies did not address these concepts systematically or quantitatively. Most of the foundation for the development of our model was driven by theory which had only scant empirical support. Therefore, it should be expected that the model will require a few modifications.

Future directions and extensions of the current study should follow a planned progression. The first course of extended research should address measurement and construct

validity issues regarding cognitive deficits, awareness deficits, and denial. Once it has been determined that the measures of these constructs are valid then modifications in the model can be made. Next the model should be replicated on a new set of severe closed head injury patients. Following satisfactory replication, the model can be extended to assess different patient groups with known neurological impairments (mild and moderate head injury, cerebral vascular accident, and dementia). Following satisfactory cross-validation on several neurological populations then research could go on to include the variables in the wider model.

One way to address the measurement and construct related issues would be to test the model with different cognitive measures which would be related to comparative self-knowledge. Coben et al. (1994) suggests that frontal mediated executive functions would be the best candidates, and our post-hoc analyses found that post-injury IQ was related to comparative self-knowledge. In order to address the problem of premorbid cognitive abilities, discrepancy scores could be calculated by obtaining the norm based z-scores for the different cognitive measures and calculating the discrepancy from a demographically based estimation of premorbid abilities (Barona, Reynolds & Chastain, 1984). This would be crude, but it would provide some measure of control of premorbid abilities. If it is again assumed that the cognitive functions being measured were indirectly assessing awareness

deficits then this would control for premorbid awareness levels as well.

In addition, further research needs to be done to determine the best measure of denial. As mentioned, the Dn-scale does not appear to be significantly better than the R-scale in predicting comparative self-knowledge or self-concept. Since investigators suggest that denial can be distinguished from awareness deficits in clinical settings, better assessment techniques need to be devised. Some suggestions would be to have trained clinicians conduct a structured interview with the patient over several test sessions. One of the components of the assessment could be how the patient responds to feedback regarding their deficits. Patients that have greater denial would be expected to become more defensive or upset than the patient with awareness deficits, who would more likely be bewildered and feckless in the face of feedback. This method would have the advantage of being specific to head-injury caused deficits.

An additional measurement question can be raised about the use of the PCRS. As reviewed earlier, studies indicate that patients may disagree with staff regarding certain functions and not others (e.g. Prigatano, Altman & O'Brien, 1990). In the future investigation of individual items that patients and and staff are more likely to disagree, may yeild a better measure of comparative self-knowledge.

Once the measurement issues are resolved an additional extension could be to analyze the lesion location of patients that have greater deficits in comparative self-knowledge. Current theory would predict that patients low in comparative self-knowledge would have more lesions in the right hemisphere and bilateral frontal regions (Stuss & Benson, 1986; Schacter, 1990; Prigatano, 1991).

The third stage of research could test the wider model, which includes the relationship between current self-concept and premorbid self-concept, and the relationship of self-concept to psychological distress. Exploratory analyses with 48 of the 57 subjects in this study, suggests that there is a significant relationship between depression and the cognitive self-concept, and the relationship between depression and the physical self-concept approached a significant level, as we had predicted in the wider model. The relationship between the cognitive self-concept/self-esteem scale and the MMPI-2 Depression scale, controlling for cognitive deficits, denial, and comparative self-knowledge, was significant (b= -.40; p < .05). The relationship between the social self-concept/self-esteem scale and the MMPI-2 Depression scale, controlling for the other variables, was not significant (b= -.03; p > .05). The relationship between the physical self-concept/self-esteem scale and the MMPI-2 Depression scale, controlling for the other variables, approached significance (b= -.28; p= .059). This suggests that investigation of the wider model is

warranted. In addition, one could attempt to assess premorbid self-concept in order to control for prior levels of self-esteem. However, assessment of premorbid self-concept has obvious practical limitations. An ideal but impractical solution would be to have the patients' self-concept ratings prior to their accidents. A more feasible way to approach this would be to use a control group. This would require assessing the self-concepts of non-head injured people matched for age, sex, education, geographic location, psychiatric history, medical history, and personality and compare their self-concept ratings with head injury patients estimations of their premorbid self-concept. This could provide evidence whether head injury patients are being accurate in their premorbid estimations of their self-concept.

Overall, it is hoped that this study helps clarify the relationship between awareness and self-concept. It is only the first step of many that need to be made before we can accurately predict how awareness is related to patients self-concept. One day we may have valid measures and techniques which can distinguish between denial and awareness deficits.

Implications for Rehabilitation

The importance of understanding awareness and self-concept in rehabilitation is clear. The literature suggests that patients that have decreased knowledge of their deficits have poorer treatment outcomes (Fordyce & Roueche, 1986;

Prigatano, Fordyce, Zeiner, Roueche, Pepping, & Wood, 1986; Lam, McMahon, Priddy, & Gehred-Schultz, 1988;), vocational outcome (Ezrachi, Ben-Yishay, Kay, Diller, & Rattock, 1991), psychosocial outcome (Prigatano, Altman, & O'Brien, 1990), and functional re-entry into society (Prigatano et al. 1986a).

Until such time as the many research questions which are still left unanswered by this study are resolved, what implications do the current findings have for the rehabilitation of head injury patients? The major findings of this study suggest that increases in self-knowledge leads to lower self-esteem, and increased cognitive impairments leads to lower cognitive self-esteem. While this latter finding is encouraging, because it suggests that some patients have the potential to be aware of deficits, it also creates a problem during rehabilitation. As stated in the introduction, patients that are unwilling to accept that they have deficits are unlikely to change their self-concept and usually are unwilling to engage in rehabilitation, and patients that do accept their deficits may suffer from low self-esteem and thus be poorly motivated for treatment. The dilemma is this: if accurate self-knowledge and healthy self-esteem are necessary for rehabilitation, and post-rehabilitation adjustment (Prigatano, & Fordyce, 1986; Johnson, & Newton, 1987), how do you go about increasing self-knowledge without damaging self-esteem? How can therapists and team members help patients

with the inherent psychological risks involved in the rehabilitation? The treatment decisions are not always clear.

These issues must be addressed programmatically. There are at least four general components that a rehabilitation treatment program must have in order for it to systematically address these issues of self-knowledge and awareness, denial, and self-concept with head injury patients. These four components can be conceptualized as a square. The first corner would represent accurate assessment of the patients strengths and weaknesses. The second corner of this rehabilitation square would be directly attempting to remediate or compensate for the deficits through various therapies (memory group, attention remediation, etc.). The third component would be patient education and the fourth would be some form of psychotherapy. While they are separate theoretically, they can in principle be addressed together in various different formats of treatment. In the center of this square would be the therapists, who must be educated about the importance of awareness and self-concept to the patients' rehabilitation. Note that there were several sources for many of these ideas (Conboy, Barth, & Boll, 1986; Prigatano, Fordyce, Zeiner, Roueche, Pepping, & Wood, 1986; Crosson, 1987; Diller, 1987; Prigatano & Klonoff, 1988; Youngblood & Altman, 1989; Lewis & Rosenberg, 1990; Barco, Crosson, Bolesta, Werts, & Stout, 1991).

The first component is assessment. This can take many forms, but at core it means developing an accurate model of a particular patient's strengths and weaknesses. At the outset of treatment, staff should assess the extent to which the patient has impairments, and to what extent these are disabling to the patient's functioning. This is typically carried out by some form of neuropsychological and psychosocial assessment (e.g. Diller, 1987; Prigatano, 1988; Sohlberg & Mateer, 1989) along with an assessment of the patients' functional impairments. This specifies which treatments are needed and indicates the areas of weakness of about which the patient needs to be aware. This evaluation process should include assessment of the patient's level of self-knowledge. Since, measurement of denial and awareness deficits is not sophisticated enough yet, as was found in this study and others, the extent to which each of these influences self-knowledge cannot be determined initially. Further assessment across time will provide a clearer picture of the relative contributions of these to self-knowledge. What can be done, however, is to assess more practical aspects of awareness. Barco et al. (1991) developed an eloquent treatment model for the remediation of deficits in intellectual awareness, emergent awareness, and anticipatory awareness, based on the Crosson et al. (1989) model of awareness. The first step, and a continuing process throughout treatment, is assessment of these different forms

of awareness. What can be done initially is to assess the patient's level of intellectual awareness; which is the foundation of the other levels of awareness in the hierarchy presented by Crosson, et al. (1989). Quantitative assessment of the patients self-concept/self-esteem would also be useful. The Adult General Self-Concept Inventory (Blascovitch & Tomaka, 1991) and the Rosenberg Self Esteem Scale (Rosenberg, 1979) could be used. There are really no other inventories which are widely used to assess self-concept and self-esteem with head injury patients.

The second component of rehabilitation includes the treatment. This can include direct neuropsychological rehabilitation of cognitive and behavioral deficits (e.g. memory retraining, social skills group, problem solving groups), along with treatment specifically for awareness deficits. As stated in the review, self-awareness is a state of conscious reflection of one's functioning, and self-knowledge is a stable form of knowledge that has the potential of developing from instances of self-awareness. Treatment can essentially provide the opportunities for the patient to observe their functioning and therefore promote self-awareness and self-knowledge. In addition, treatment can address self-concept issues. As Markus and Wurf (1987) point out, the self-concept has a working component that is continually active and dynamic. The functions of their working self-concept are similar to the functions ascribed to the frontal

lobe (Stuss & Benson, 1986). Unfortunately, this means that if patients have frontal deficits, they may also have difficulty changing their self-concept. This model of working self-concept, suggests that the self-concept is continually monitoring the environment, which should be active during treatment activities. So for patients without significant frontal executive impairments, simply being engaged in rehabilitation may provide the working self-concept with new information about the self; i.e. namely that "If I am engaged in treatment, this must mean I am having some problems."

Self-knowledge issues can be dealt with directly through a program designed to remediate awareness deficits (Barco et al. 1991). Barco et al. (1991) treat the awareness deficit directly through a series of steps that are designed to provide the patient with consistent, objective feedback about their performance. They use a variety of techniques to accomplish this, such as the use of videotaping, self-rating scales, and observation during performance of a task. They propose a decision tree to which professionals may refer when attempting to remediate the patient's awareness deficits. The process begins with assessment for intellectual awareness, if it is deficient, then training in this form of awareness is undertaken. If it fails, then external compensations must be made. If successful, then assessment of emergent awareness is done. Training to improve emergent awareness is undertaken; if they show poor emergent awareness, and it cannot be

changed, then situational compensation may also be utilized. The same process occurs for anticipatory awareness. If this form of awareness deficit cannot be remediated, then recognition compensations can be undertaken. If they have anticipatory awareness then anticipatory compensations also may be used. An important advantage of this model is that it addresses the type of patients that can state their deficits explicitly, but do not recognize when their deficit is causing them a problem. An important component of this awareness retraining is the consistent use, by the staff, of a simplified label for the patient's deficit. This minimizes patient confusion and ensures that the patient is getting correct feedback. Awareness issues can also be dealt with indirectly by providing opportunities for them to observe their functioning during a variety of tasks. In addition, self-concept issues can be addressed by pointing out strengths and weaknesses in an objective but caring way. The data in this study suggests that increasing self-knowledge will have the effect of decreasing self-concept. To some degree, changes in self-concept are a necessary stage that the patient must go through (Deaton, 1986), and staff should understand this. As Bednar, Wells & Peterson (1989) point out, consistently coping with the source of negative evaluative feedback will ultimately result in high self-esteem. However, the therapist must have an effective therapeutic alliance with the patient, i.e. the patient must trust the therapist. Part

of this trust is knowing that the therapist is doing what is in the patient's best interest. This may mean backing off from the treatment goals for a short while, if the patient's self-concept is declining too quickly. This can go a long way in reducing the negative consequences of self-concept change.

The third component of a rehabilitation program is patient education. The importance of this component for remediation of self-knowledge deficits is highlighted by the Gasquoine (1992). He found that if patients did not understand the meaning of cognitive terms, they showed impaired self-knowledge. In fact the very term, self-knowledge, implies that providing patients with knowledge can be a first step in applying it to themselves. This can be accomplished throughout the treatments mentioned above and can be done in some form of structured format. Many rehabilitation programs include an educational component (e.g. Prigatano et al., 1986), where patients are educated about the effects of brain injury on physical, cognitive, social, psychological functioning. An additional component to such education could include explanation of the balance between awareness, self-knowledge and self-concept following head injury.

The final component of the program is psychotherapy. Psychotherapy addresses both the self-knowledge impairments and self-concept. A very important element, particularly in doing psychotherapy, is to establish an effective therapeutic

alliance. This lays the foundation for increasing awareness while not causing low self-esteem. Many rehabilitation programs have some form of psychotherapy as a required element (e.g. Prigatano et al., 1986; Lewis & Rosenberg, 1987; Crosson, 1987). This can include group treatment, individual treatment, behavior modification, and be part of individual staff-patient interactions (Crosson, 1987). Some of the basic elements of psychotherapy with non-head injured patients, includes a focus on increasing awareness, and addressing affect. This is similar to what can be done in psychotherapy with head injury patients. While there are several limitations to doing psychotherapy with head injury patients (e.g. memory impairments), it often can be done successfully (Prigatano, 1986). Prigatano (1986) suggests psychotherapy provides an arena in which the patients' affective reactions to events can be addressed. He states that the goal of such therapy is a state of acceptance. This can be conceptualized as meaning that the patient is comfortable with their modified self-concept. Their new self-concept can incorporate their current level of functioning without unnecessary negative evaluation, i.e. their self-esteem is intact. As the patient becomes accustomed to their new selves their self-esteem and self-acceptance should rise. As mentioned above, investigators suggest that self-concept must go through this change following a life-altering event such as a head injury

(e.g. Deaton, 1986), and psychotherapy can play a pivotal role in making this transition.

A programmatic commitment to ameliorating self-knowledge impairments and addressing self-concept issues can effectively deal with the problem posed earlier. Self-knowledge can be increased while not allowing self-concept to sink too low. However, for some patients this may not be effective, and in some cases, rehabilitation would have to be deferred. This exposition of the treatment planning is by no means meant to be exhaustive, but it suggests some possible implications for the current study.

REFERENCES

Adamovich, B.L.B. (1991). Cognition, language, attention, and information processing following closed head injury, In J.S. Kreutzer, & P.H. Wehman (Eds.), Cognitive rehabilitation for persons with traumatic brain injury: A functional approach, Baltimore: Paul H. Brooks Publishing Co.

Adams, R.D., & Victor, M. (1989). Principles of neurology, New York: Mcgraw-Hill.

Agresti, A., & Finlay, B. (1986). Statistical methods for the social sciences. San Francisco, CA: Dellen Publishing Company.

Alfano, D.P., Neilson, P.M., Paniak, C.E., & Finlayson, M.A.J. (1992). The MMPI and closed-head injury. The Clinical Neuropsychologist, 6(2), 134-142.

Allen, C.C., & Ruff, R.M. (1990). Self-rating versus neuropsychological performance of moderate versus severe head-injured patients. Brain Injury, 4(1), 7-17.

Anderson, S.W., & Tranel, D. (1989). Awareness of disease states following cerebral infarction, dementia, and head trauma: Standardized assessment. The Clinical Neuropsychologist, 3(4), 327-339.

Armstrong, C. (1991). Emotional changes following brain injury: Psychological and neurological components of depression, denial and anxiety. Journal of Rehabilitation, 57(2), 15-22.

Babinski, J. (1914). Contribution a l'Etude des troubles mentaux dans l'Hemiplegie organique cerebrale (Anosognosie). Review of Neurology, 27, 845-847.

Baddeley, A.D. (1981). The concept of working memory: A view of its current state and probable future development. Cognition, 10, 17-23.

Baddeley, A., Harris, J., Sunderland, A., Watts, K.P., & Wilson, B.A. (1987). Closed head injury and memory. In H.S. Levin, J. Grafman, & H.M. Eisenberg (Ed.), Neurobehavioral recovery from head injury. New York: Oxford University Press.

Baddeley, A.D., & Hitch, G.J. (1974). Working memory. In G. Bower (Ed.), The Psychology of Learning and Motivation(Vol. 8, 47-90). San Diego, CA: Academic Press.

Baddeley, A.D., Logie, R., Bressi, S., Della Sala, S., & Spinnler, H. (1986). Dementia and working memory. Quarterly Journal of Experimental Psychology, 38A, 603-618.

Barco, P.P., Crosson, B., Bolesta, M.M., Werts, D., & Stout, R. (1991). Training awareness and compensation in postacute head injury rehabilitation. In J.S. Kreutzer, & Wehman, P.H. (Eds.), Cognitive rehabilitation for persons with traumatic brain injury (pp. 129-146), Baltimore: Brooks Publishing.

Bednar, R.L., Wells, M.G., & Peterson, S.R. (1989). Self-esteem: Paradoxes and Innovations in clinical theory and practice. Washington, DC: American Psychological Association.

Bergquist, T.F., & Jacket, M.P. (1993). Awareness and goal setting with the traumatically brain injured. Brain Injury, in press.

Bergquist, T.F., & Malec, J.F. (1993, February). Relationship of self-awareness, neuropsychological status, and severity of traumatic brain injury. Journal of Clinical and Experimental Neuropsychology, 1(15), 107.

Barona, A., Reynolds, C.R., & Chastain, R. (1984). A demographically based index of premorbid intelligence for the WAIS-R. Journal of Consulting and Clinical Psychology, 52, 885-887.

Bisiach, E., Vallar, G., Perani, D., Papagno, C., & Berti, A. (1986) Unawareness of disease following lesions to the right hemisphere: Anosognosia for hemiplegia and anosognosia for hemianopia. Neuropsychologia, 24, 471-482.

Bisiach, E., & Geminiani, G. (1991). Anosognosia related to hemiplegia and hemianopia. In G.P. Prigatano, and D.L. Schacter (Eds.), Awareness of deficit after brain injury: Clinical and theoretical issues. New York: Oxford University Press.

Blake, M. (1973). Prediction of recognition when recall fails: Exploring the feeling-of-knowing phenomenon. Journal of Verbal learning and Verbal Behavior, 12, 311-319.

Blashcovich, J., & Tomaka, J. (1991). Measures of Self-esteem. In J.P. Robinson, P.R. Shaver, & L.S. Wrightsman, (Eds.) Measures of personality and social psychological attitudes; 115-155; New York: Academic Press.

Boake, C., Freeland, J., Ringholz, G.M., Nance, M., & Edward, K.E. (1987). Awareness of memory loss after severe head injury. Journal of Clinical and Experimental Neuropsychology, 9, 53 (Abstract).

Bond, M.R. (1986). Neurobehavioral consequences of closed head injury. In I. Grant, & K.M. Adams, Neuropsychological assessment of neuropsychiatric disorders, New York: Oxford University Press.

Borod, J.C., Goodglass, H., & Kaplan, E. (1980). Normative data on the boston diagnostic aphasia examination, parietal lobe battery, and the boston naming test. Journal of Clinical Neuropsychology, 2(3), 209-215.

Branden, N. (1969). The psychology of self-esteem. New York: Nash Publishing.

Breier, J.I., Adair, J.C., Gold, M., Fennell, E.B., Gilmore, R.L., Heilman, K.M. (In Press). Dissociation of anosognosia for hemiplegia and aphasia during left hemisphere anesthesia. Neurology.

Buchtel, H.A. (1987). Attention and vigilance after head trauma. In H.S. Levin, J. Grafman, & H.M. Eisenberg (Ed.), Neurobehavioral recovery from head injury. New York: Oxford University Press.

Caldwell, A.C. (1988). MMPI Supplemental Scale manual. Los Angeles, CA: Caldwell Report.

Carver, C., & Scheier, M.F. (1982). Self-awareness and the self-regulation of behavior. In G. Underwood (Eds.) Aspects of Consciousness, Vol. 3: Awareness and Self-Awareness. New York: Academic Press.

Coben, R.A., Boksenbaum, S.I., & Kulberg, A.M. (1994). Cognitive determinants of unawareness of deficits: The importance of specific frontal-mediated executive functions. Poster presented at the National Academy of Neuropsychology meeting in Orlando, Florida.

Cockburn, J., Wilson, B., & Baddeley, A. (1986). How well do people with memory problems recognise their difficulties? Unpublished manuscript.

Code, C. (1986). Catastrophic reaction and anosognosia in anterior-posterior and left-right models of cerebral control of emotion. Psychological Research, 48, 53-55.

Cohen, J., & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences. (2ed), Hillsdale, NJ; Lawrence Erlbaum Associates.

Conboy, T.J., Barth, J., & Boll, T.B., (1986). Treatment and rehabilitation of mild to moderate head trauma. Rehabilitation Psychology, 31(4), 203-215.

Cooley, E.L., & Stringer, A.Y. (1991). Self and observer predictions of memory performance in a brain damaged sample. Archives of Clinical Neuropsychology, 6, 355-362.

Corrigan, J.D. (1995). Substance abuse as a mediating factor in outcome from traumatic brain injury. Archives of Physical Medicine Rehabilitation, 76, 302-309.

Corrigan, J.D., Arnett, J.D., Houck, L.J., & Jackson, R.D., (1985). Reality orientation for brain injured patients: Group treatment and monitoring of recovery. Archives of Physical Medicine Rehabilitation, 66, 675-684.

Corrigan, J.D., & Jackson, R.D. (1984). Prospective system for monitoring length of post-traumatic amnesia. Archives of Physical Medicine and Rehabilitation, 65, 652.

Cowan, N. (1988). Evolving conceptions of memory storage, selective attention, and their mutual constraints within the human information-processing system. Psychological Bulletin, 104(2), 163-191.

Crosson, B. (1987). Treatment for interpersonal deficits for head-trauma patients in inpatient rehabilitation settings, The Clinical Neuropsychologist, 1(4), 335-352.

Crosson, B., Barco, P.P., Velozo, C.Z., Bolesta, M.M., Cooper, P., Werts, D., & Brobeck, T.C. (1989). Awareness and compensation in postacute head injury rehabilitation. The Journal of Head Trauma Rehabilitation, 4(3), 46-54.

Cutting, J. (1978). Study of anosognosia. Journal of Neurology, Neurosurgery, and Psychiatry, 41, 548-555.

Dahlstrom, W.G., Welsch, G.S., Dahlstrom, L.E. (1975). An MMPI handbook, Volume II: Research applications. University of Minnesota Press: Minneapolis, MN.

Deaton, A.V. (1986). Denial in the aftermath of traumatic head injury: It's manifestations, measurement, and treatment. Rehabilitation Psychology, 31(4), 231-240.

Dikmen, S.S., Machamer, J.E., Winn, H.R., Temkin, N.R. (1995). Neuropsychological Outcome 1-Year Post Head Injury. Neuropsychology, 9(1), 80-90.

Dikmen, S.S., Ross, B.L., Machamer, J.E., & Temkin, N.R. (1995). One year psychosocial outcome in head injury. Journal of the International Neuropsychological Society, 1(1), 67-77.

Diller, L. (1987). Neuropsychological rehabilitation. In M.J. Meier, A. Benton, & L. Diller, Neuropsychological Rehabilitation, New York: Guilford Press.

Epstein, S. (1987). Implications of cognitive self theory for psychopathology and psychotherapy. In N. Cheshire and H. Thomae (Ed.) Self symptoms and psychotherapy. New York: Wiley & Sons.

Ezrachi, O., Ben-Yishay, Y., Kay, T., Diller, L., Rattock, J. (1991). Predicting employment in traumatic brain injury following neuropsychological rehabilitation. Journal of Head Trauma Rehabilitation, 6, 71-84.

Fahy, T.J., Irving, M.H., & Millac, P. (1967). Severe head injuries - A six year follow-up. Lancet, 2, 475-479.

Fleming, J.S., & Watts, W.A. (1980). The dimensionality of self-esteem: Some results for a college sample. Journal of Personality and Social Psychology, 39, 921-929.

Fleming, J.S., & Courtney, B.E. (1984). The dimensionality of self-esteem: II. Hierarchical facet model for revised measurement scales. Journal of Personality and Social Psychology, 46(2), 404-421.

Fleming, J.S., & Whalen, D.J. (1990). The personal and academic self-concept inventory: Factor structure and gender differences in high school and college samples. Educational and Psychological Measurement, 50, 957-967.

Ford, B. (1976). Head injuries - What happens to survivors. The Medical Journal of Australia, 1, 603-605.

Fordyce, D.J. (1983). Psychometric assessment of denial of illness in brain injury patients. Paper presented at the 91st annual convention of the American Psychological Association, Anaheim, CA.

Fordyce, D.J., Roueche, J.R., & Prigatano, G.P. (1983). Enhanced emotional reactions in chronic head trauma patients. Journal of Neurology, Neurosurgery, and Psychiatry, 46, 620-624.

Fordyce, D.J., & Roueche, J.R. (1986). Changes in perspectives of disability among patients, staff, and relatives during rehabilitation of brain injury. Rehabilitation Psychology, 31(4), 217-229.

Gainotti, G. (1972). Emotional behavior and hemispheric side of the lesion. Cortex, 8, 41-45.

Gans, J.S. (1983). Hate in the rehabilitation setting. Archives of Physical Medicine and Rehabilitation, 64, 176-179.

Gasquoine, P.G. (1992). Affective state and awareness of sensory and cognitive effects after closed head injury. Neuropsychology, 6(3), 187-196.

Gecas, V. (1982). The self-concept. Annual Review of Sociology, 8, 1-33.

Goldberg, E., & Barr, W.B. (1991). Three possible mechanisms of unawareness of deficit. In G.P. Prigatano, and D.L. Schacter, Awareness of deficit after brain injury, New York: Oxford University Press.

Goldman-Rakic, P.S. (1992). Working memory and the mind. Scientific American, Sept., 111-117.

Goldstein, K. (1952). The effects of brain damage on the personality. Psychiatry, 15, 245-260.

Gouvier, W.D., Blanton, P.D., LaPorte, K.K., & Nepomuceno, C. (1987). Reliability and validity of the disability rating scale and the levels of cognitive functioning scale in monitoring recovery from severe head injury. Archives of Physical Medicine and Rehabilitation, 68(2), 94-97.

Greene, R.L. (1991). The MMPI-2/MMPI: An interpretive manual. Needham Heights, Massachusetts: Simon & Schuster.

Gronwall, D. (1989). Cumulative and persisting effects of concussion on attention an cognition. In H.S. Levin, H.M. Eisenberg, & A.L. Benton, Mild head injury (Eds.), New York: Oxford University Press.

Groswasser, Z., Mendelson, L., Stern, M.J., Schechter, I., & Najenson, T. (1977). Re-evaluation of prognostic factors in rehabilitation after severe head injury. Scandinavian Journal of Rehabilitation Medicine, 9, 147-149.

Hagen, C., Malkmus, D., & Durham, P. (1979). Levels of cognitive functioning. In Rehabilitation of the head injured adult: Comprehensive physical management (pp. 8-11). Downey, CA: Professional Staff Association of Rancho Los Amigos Hospital.

Harder, D.W. (1984). Character style of the defensively high self esteem man. Journal of Clinical Psychology,40, 26-35.

Harter, S. (1983). Developmental perspectives on the self-system. In P.H. Mussen (Ed.), Handbook of Child Psychology (Vol.4, 4th ed., pp. 275-385). New York: Wiley.

Hathaway, S.R., & McKinley, J.C. (1989). Manual for administration and scoring: MMPI-2. Minneapolis, MN: University of Minnesota Press.

Heaton, R.K. (1981). Wisconsin Card Sorting Test Manual. Odessa, Fl: Psychological Assessment Resources.

Heilbronner, R.L., Millsaps, C., Azrin, R., & Mittenberg, W. (1993). Psychometric properties of the Patient Competency Rating Scale. Journal of Clinical and Experimental Neuropsychology, 15, p. 67 (Abstract).

Heilman, K.M., & Valenstein, E. (1972). Auditory neglect in man. Archives of Neurology, 26, 32-35.

Heilman, K.M. (1991). Anosognosia: Possible neuropsychological mechanisms. In G.P. Prigatano, and D.L. Schacter (Eds.), Awareness of deficit after brain injury: Clinical and theoretical issues. New York: Oxford University Press.

Heilman, K.M., Watson, R.T., & Valenstein, E. (1985). Neglect and related disorders. In K.M. Heilman, and E. Valenstein (Eds.), Clinical Neuropsychology, New York: Oxford University Press.

Heir, D.B. , Mondlock, J., & Caplan, L.R. (1983). Behavioral abnormalities after right hemisphere stroke. Neurology, 33, 337-344.

Hibbard, M.R., Gordon, W.A., Stein, P.N., Grober, S., & Sliwinski, M. (1992). Awareness of disability in patients following stroke. Rehabilitation Psychology, 37(2), 103-120.

Higgins, E.T., Klein, R., & Straumann,T. (1985). Self-concept discrepancy theory: A psychological model for distinguishing among different aspects of depression and anxiety. Social Cognition, 3, 51-76.

Hinkeldey, N.S., & Corrigan, J.D. (1990). The structure of head-injured patients' neurobehavioral complaints: a preliminary study. Brain Injury, 4(2), 115-133.

Holbourn, A.H.S. (1943). Mechanics of head injuries. Lancet, 2, 438-441.

Horney, K. (1937). The neurotic personality of our time. New York: Norton.

Jackson, R.D., Mysiw, W.J., & Corrigan, J.D. (1989). Orientation group monitoring system: An indicator for reversible impairments in cognition in posttraumatic amnesia. Archives of Physical Medicine and Rehabilitation, 70, 33-36.

James, W. (1890). The Principles of Psychology. New York: Henry Holt and Company.

Janis, I.L., & Field, P.B. (1959). Sex differences and factors related to persuasibility. In C.I. Hoveland & I.L. Janis (Eds.), Personality and persuasibility (pp 55-68). New Haven, CT: Yale University Press.

Jennett, B., Snoek, J., Bond, M.R., & Brooks, N. (1981). Disability after severe head injury: observations on the use of the Glasgow Outcome Scale. Journal of Neurology, Neurosurgery, and Psychiatry, 44, 285-293.

Jennett, B., & Teasdale, G. (1977). Aspects of coma after severe head injury. The Lancet, 1, 878-881.

Jennett, B., & Teasdale, G. (1981). Management of head injuries. Philadelphia: F.A. Davis Company.

Johnson, D.A., & Newton, A. (1987). HIPSIG: A basis for social adjustment after head injury. British Journal of Occupational Therapy, 50(2), 47-52.

Johnson-Laird, P.N. (1988). A computational analysis of consciousness. In A.J. Marcel and E. Bisiach (eds.), Consciousness in contemporary science. New York: Oxford University Press, 357-368.

Kihlstrom, J.F., & Tobias, B.A. (1991). Anosognosia, consciousness, and the self. In G.P. Prigatano, and D.L. Schacter (Eds.), Awareness of deficit after brain injury: Clinical and theoretical issues. New York: Oxford University Press.

Klonoff, P.S., & Lage, G.A. (1991). Narcissistic injury in patients with traumatic brain injury. The Journal of Head Trauma Rehabilitation, 6(4), 11-21.

Korner-Bitensky, N., Mayo, N.E., & Poznanski, S.G. (1990). Occupational therapists' accuracy in predicting sensory, perceptual-cognitive, and functional recovery post-stroke. The Occupational Therapy Journal of Research, 10(4), 237-249.

Kreutzer, J.S., Devany, C.W., Myers, S.L., & Marwitz, J.H. (1991). Neurobehavioral outcome following traumatic brain injury, In J.S. Kreutzer, & P.H. Wehman (Eds.), Cognitive rehabilitation for persons with traumatic brain injury: A functional approach, Baltimore: Paul H. Brooks Publishing Co.

Kreutzer, J.S., & Wehman, P.H. (1991). Cognitive rehabilitation for persons with traumatic brain injury: A functional approach, Baltimore: Paul H. Brooks Publishing Co.

Lam, C., McMahon, B., Priddy, D., & Gehred-Schultz, A. (1988). Deficit awareness and treatment performance among traumatic head injury adults. Brain Injury, 2, 235-242.

Levin, H.S., & Grossman, R.G. (1978). Behavioral sequelae of closed head injury: A quantitative study. Archives of Neurology, 35,720-727.

Levin, H.S., Benton, A.L., Grossman, R.G. (1982). Neurobehavioral consequences of closed head injury. New York: Oxford University Press.

Levine, D.N. (1990). Unawareness of visual and sensorimotor deficits: A hypothesis. Brain and Cognition, 13, 233-281.

Levine, J., & Zigler, E. (1975). Denial and self-image in stroke, lung cancer, and heart disease patients. Journal of Consulting and Clinical Psychology, 43(6), 751-757.

Lewis, L. (1991). The role of psychological factors in disordered awareness. In G.P. Prigatano, and D.L. Schacter (Eds.), Awareness of deficit after brain injury: Clinical and theoretical issues. New York: Oxford University Press.

Lewis, L., & Rosenberg, S.J. (1990). Psychoanalytic psychotherapy with brain injured adult psychiatric patients. The Journal of Nervous and Mental Disease, 178(2), 69-77.

Lezak, M.D. (1983). Neuropsychological assessment, New York: Oxford University Press.

Lezak, M. (1987). Assessment for rehabilitation planning. In M.J. Meir, A.L. Benton, & L. Diller (Eds.), Neuropsychological Rehabilitation. New York: The Guilford Press.

Lezak, M.D. (1988). Brain damage is a family affair, Journal of Clinical and Experimental Neuropsychology, 10(1), 111-123.

Lishman, W.A. (1978). Head injury. In W.A. Lishman (Eds.), Organic Psychiatry: The psychological consequences of cerebral disorder. (pp. 191-261). Oxford: Blackwell Scientific Publications.

Little, K.B., & Fisher, J. (1958). Two new experimental scales of the MMPI. Journal of Consulting Psychology, 22(4), 305-306.

Lynch, K.R. (1989). A description of self-concept following traumatic brain injury. Unpublished doctoral dissertation; Boston University; Boston, MA.

Malzer, R.L. (1988). Patient performance level during inpatient physical rehabilitation: Therapist, nurse and patient perspectives. Archives of Physical Medicine and Rehabilitation, 69, 363-365.

Markus, H., & Wurf, E. (1987). The dynamic self-concept: A social psychological perspective. Annual Review of Psychology, 38, 299-337.

McGlynn, S.M., & Schacter, D.L. (1989) Unawareness of deficits in neuropsychological syndromes. Journal of Clinical and Experimental Neuropsychology, 11(2), 143-205.

McKinley, W.W., & Brooks, D.N. (1984). Methodological problems in assessing psychosocial recovery following severe head injury. Journal of Clinical Neuropsychology, 6(1), 87-99.

McKinley, W.W., Brooks, D.N., Bond, M.R., Martinage, D.P., & Marshall, M.M. (1981). The short-term outcome of severe blunt head injury as reported by relatives of the injured persons. Journal of Neurology, Neurosurgery, and Psychiatry, 44, 527-533.

Memorial Regional Rehabilitation Center: Brain Injury Programmatic Development Committee (1991). Functional Assessment Scale; Memorial Regional Rehabilitation Center; Jacksonville, Florida.

Miller, H., & Stern, G. (1965). The long-term prognosis of severe head injury. The Lancet, I, 225-229.

Mysiw, W.J., Corrigan, J.D., Carpenter, D., & Chock, S.K.L. (1990). Prospective assessment of posttraumatic amnesia: A comparison of the GOAT and the OGMS. Journal of Head Trauma Rehabilitation, 5(1), 65-72.

Mysiw, W.J., Jackson, R.D., & Corrigan, J.D. (1988). Amitriptyline for post-traumatic agitation. American journal of physical medicine and rehabilitation, 67(1), 29-33.

National Head Injury Foundation, Florida Association Inc. (1991). Introduction to National Head Injury Foundation, Florida Association, Pompano Beach, Florida: National Head Injury Association.

Newton, A., & Johnson, D.A. (1985). Social adjustment and interaction after severe head injury. British Journal of Clinical Psychology, 24, 225-234.

Norusis, M.J. (1990). SPSSx/PC+ Statistics 3.0. Chicago, Il: SPSS Inc.

Oddy, M., Coughlan, T., Tyerman, A., & Jenkins, D. (1985). Social adjustment after closed head injury: a further follow-up seven years after injury. Journal of Neurology, Neurosurgery, and Psychiatry, 48(6), 564-568.

Olson, B. (1990) Neuropsychological assessment as a means to modify denial of cognitive deficits in brain injured individuals. Dissertation, University of Miami. Miami, FL.

Pedhauzer, E.J. (1982). Introduction to Linear structural relations (LISREL), In E.J. Pedhauzer, Multiple regression in behavioral research (2nd Eds.), New York: Dryden Press, 636-681.

Peterson, L.R., & Peterson, M.J. (1959). Short term retention of individual verbal items. Journal of Experimental Psychology, 58, 193-198.

Posner, M.I., & Rafal, R.D. (1987). Cognitive theories of attention and the rehabilitation of attentional deficits. In M.J. Meier, A. Benton, & L. Diller, Neuropsychological Rehabilitation (Eds.), New York: Guilford Press.

Povlishock, J.T., & Coburn, T.H. (1989). Morphopathological change associated with mild head injury. In H.S. Levin, H.M. Eisenberg, & A.L. Benton, Mild head injury (Eds.), New York: Oxford University Press.

Prevey, M.L., Delaney, R.C., & Mattson, R.H. (1988). Metamemory in temporal lobe epilepsy: Self-monitoring of memory functions. Brain and Cognition, 7, 298-311.

Prigatano, G.P. (1986a). Psychotherapy after brain injury. In G.P. Prigatano, D.J. Fordyce, H.K. Zeiner, J.R. Roueche, M. Pepping, and M.C. Wood (Ed.) Neuropsychological rehabilitation after brain injury. Baltimore: Johns Hopkins University Press.

Prigatano, G.P. (1986b). The patient competency rating scale. In G.P. Prigatano, D.J. Fordyce, H.K. Zeiner, J.R. Roueche, M. Pepping, and M.C. Wood (Ed.) Neuropsychological rehabilitation after brain injury. Baltimore: Johns Hopkins University Press.

Prigatano, G.P. (1987). Psychiatric aspects of head injury: Problems areas and suggested guidelines for research. In H.S. Levin, J. Grafman, & H.M. Eisenberg (Ed.), Neurobehavioral recovery from head injury. New York: Oxford University Press.

Prigatano, G.P. (1991). Disturbances of self-awareness of deficit after traumatic brain injury. In G.P. Prigatano, and D.L. Schacter (Eds.), Awareness of deficit after brain injury: Clinical and theoretical issues. New York: Oxford University Press.

Prigatano, G.P., Altman, I.M., & O'Brien, K.P. (1990). Behavioral limitations that traumatic-brain-injured patients tend to underestimate. The Clinical Neuropsychologist, 4(2), 163-176.

Prigatano, G.P., & Fordyce, D.J. (1986). Cognitive dysfunction and psychosocial adjustment after brain injury. In G.P. Prigatano, D.J. Fordyce, H.K. Zeiner, J.R. Roueche, M. Pepping, and M.C. Wood (Ed.) Neuropsychological rehabilitation after brain injury. Baltimore: Johns Hopkins University Press.

Prigatano, G.P., Fordyce, D.J., Zeiner, H.K., Roueche, J.R., Pepping, M., & Wood, B.C. (1986). Neuropsychological rehabilitation after brain injury. Baltimore: Johns Hopkins University Press.

Prigatano, G.P., & Klonoff, P.S. (1988). Psychotherapy and neuropsychological assessment after brain injury. Journal of Head Trauma Rehabilitation, 3(1), 45-56.

Prigatano, G.P., & Leathem, J.M. (1993). Awareness of behavioral limitations after traumatic brain injury: A cross-cultural study of New Zealand Maoris and Non-Maoris. The Clinical Neuropsychologist, 7(2), 123-135.

Prigatano, G.P., & Schacter, D.L. (1991). Awareness of deficit after brain injury: Clinical and theoretical issues. New York: Oxford University Press.

Ranseen, J.D., & Bohaska, L.A. (1987, February). Self-awareness following traumatic brain injury. Paper presented at the International Neuropsychological Society, Washington, D.C.

Reitan, R.M., & Wolfson, D. (1986). Traumatic brain injury: Volume I Pathophysiology and neuropsychological evaluation. Neuropsychology Press, Tuson: AZ.

Rimel, R.W., Giordini, B., Barth, J.T., Boll, T.J., & Jane, J.A. (1981). Disability caused by minor head injury. Neurosurgery, 9, 221-228.

Robinson, A.L., Heaton, R.K., Lehman, R.A.W., & Stilson, D.W. (1980). The utility of the wisconsin card sorting test in detecting and localizing frontal lobe lesions. Journal of Consulting and Clinical Psychology, 48(5), 605-614.

Robinson, R.G., Kenneth, K.L., Starr, L.B., Rao, K., & Price, T.R. (1984). Mood disorders in stroke patients: Importance of location of lesion. Brain, 107, 81-93.

Robson, P.J. (1988). Self esteem, A psychiatric view. British Journal of Psychiatry, 153, 6-15.

Rogers, C.R. (1959). A theory of therapy, personality, and interpersonal relationships, as developed in a client centered framework. In S. Koch (Eds.). Psychology: A study of a science. Vol. 3 (pp 184-256). New York: McGraw- Hill Book Company.

Rogers, C.R. (1961). On becoming a person. Boston: Houghton Mifflin Company.

Rosenberg, M. (1979). Conceiving the self. New York: Basic Books.

Rosenberg, M. (1989). Society and the adolescent self-image. Middletown, CT.: Wesleyan University Press.

Roth, D.L., & Crosson, B. (1985). Memory span and long-term memory deficit in brain impaired patients. Journal of Clinical Psychology, 25, 257-292.

Roueche, J.R., & Fordyce, D.J. (1983). Perception of deficits following brain injury and their impact on psychosocial adjustments. Cognitive Rehabilitation, 1, 4-7.

Rubens, A.B. & Garrett, M.F. (1991). Anosognosia for linguistic deficits in patients with neurological deficits. In G.P. Prigatano, and D.L. Schacter (Eds.), Awareness of deficit after brain injury: Clinical and theoretical issues. New York: Oxford University Press.

Schacter, D.L. (1990). Toward a cognitive neuropsychology of awareness: Implicit knowledge and anosognosia. Journal of Clinical and Experimental Neuropsychology, 12(1), 155-178.

Schacter, D.L. (1991). Unawareness of deficit and unawareness of knowledge in patients with memory disorders. In G.P. Prigatano, and D.L. Schacter, Awareness of deficit after brain injury, New York: Oxford University Press.

Schacter, D.L., McLachlan, D.R., Moscovitch, M. & Tulving, E. (1986). Monitoring of recall performance by memory-disordered patients. Journal of Clinical and Experimental Neuropsychology, 8, 103 (Abstract).

Schoenhuber, R., & Gentilini, M. (1988). Anxiety and depression after mild head injury: A case control study. Journal of Neurology, Neurosurgery, and Psychiatry, 51, 722-724.

Shavelson, R.J., Hubner, J.J., & Stanton, G.C. (1976). Self-concept: Validation of construct interpretations. Review of Educational Research, 46(3), 407-441.

Shimamura, A.P., & Squire, L.R. (1986). Memory and metamemory: A study of the feeling-of-knowing phenomenon in amnesic patients. Journal of Experimental Psychology: Learning, Memory, and Cognition, 12(3), 452-460.

Shin, D.Y., Ehrenberg, B., Whyte, J., Bach, J., & DeLisa, J.A. (1989). Evoked potential assessment: utility in prognosis of chronic head injury. Archives of Physical Medicine and Rehabilitation, 70(3), 189-193.

Shrauger, S.J., & Terbovic, M.L. (1976) Self evaluation and assessment of performance by self and others. Journal of Consulting and Clinical Psychology, 44 (4), 564-572.

Sohlberg, M.M., & Mateer, C.A. (1989). Introduction to cognitive rehabilitation: Theory and practice, New York: Guilford Press.

Spreen, O., & Benton, A.L. (1977). Neurosensory Center Comprehensive Examination for Aphasia (NCCEA). (Revised edition). Victoria: University of Victoria, Neuropsychology Laboratory.

Starkstein, S.E., Fedoroff, J.P., Price, T.R., Leiguarda, R., & Robinson, R.G. (1992). Anosognosia in patients with cerebrovascular lesions: a study of causative factors. Stroke, 23, 1446-1453.

Starkstein, S.E., Fedoroff, J.P., Price, T.R., Leiguarda, R., & Robinson, R.G. (1993). Neuropsychological deficits in patients with anosognosia. Neuropsychiatry, Neuropsychology, and Behavioral Neurology, 6 (1), 43-48.

Stringer, A.Y., Cooley, E.L., & Kertay, L. (1988). Accuracy of predictions of everyday memory performance by brain damaged patients. Presented at the annual meeting of the National Academy of Neuropsychology, Orlando, Florida.

Stuss, D.T. (1987). Contributions of frontal lobe injury to cognitive impairment after closed head injury: Methods of assessment and recent findings. In H.S. Levin, J. Grafman, & H.M. Eisenberg (Ed.), Neurobehavioral recovery from head injury. New York: Oxford University Press.

Stuss, D.T. (1991). Disturbance of self-awareness after frontal system damage, In G.P. Prigatano, and D.L. Schacter, Awareness of deficit after brain injury, New York: Oxford University Press.

Stuss, D.T., & Benson, D.F. (1986). The frontal lobes. New York: Raven Press.

Stuss, D.T., Stethem, L.L., Hugenholtz, H., & Richard, M.T. (1989). Traumatic brain injury: A comparison of three clinical tests, and analyses of recovery. The Clinical Neuropsychologist, 3(2), 145-156.

Sunderland, A., Harris, J.E., & Baddeley, A.I. (1983). Do laboratory tests predict everyday memory? A neuropsychological study. Journal of Verbal Learning and Verbal Behavior, 22, 341-357.

Taylor, S.E., & Brown, J.D. (1988). Illusion an well-being: A social psychological perspective on mental health. Psychological Bulletin, 103(2), 193-210.

Thomas, K.R. (1990). Self-reported self-esteem and depression: Indices of psychosocial functioning in the community following severe traumatic brain injury. Dissertation. University of Wisconsin, Madison, Wisconsin.

Tyerman, A., & Humphrey, M. (1984) Changes in self-concept following severe head injury. International Journal of Rehabilitation Research, 7(1), 11-23.

Wagner, M.T., & Cushman, L.A. (1994). Neuroanatomic and neuropsychological predictors of unawareness of cognitive deficit in the vascular population. Archives of Clinical Neuropsychology, 9, 57-69.

Watson, C.G., Plemel, D., Vassar, P., Manifold, V., Kucala, T., & Anderson, D. (1987). The comparative validities of six MMPI repression scales. Journal of Clinical Psychology, 43(5), 472-477.

Wechsler, D. (1981). Wechsler Adult Intelligence Scale - Revised. New York: Psychological Corporation.

Wechsler, D. (1987). Wechsler Memory Scale-Revised. Manual. New York: Psychological Corporation.

Weinstein, E.A., & Kahn, R.L. (1955). Denial of illness, Chicago, Illinois: Charles C. Thomas.

Wilson, B. (1987). Rehabilitation of memory. New York: Guilford Press.

Wilson, B., Cockburn, J., & Baddeley, A. (1991). The Rivermead Behavioural Memory Test manual. (Ed.) Bury St. Edmunds, England: Thames Valley Test Company.

Youngblood, J.R., & Altman, I.M. (1989). A performance-based group approach to the treatment of anosognosia and denial. Rehabilitation Psychology, 34(3), 217-222.

APPENDIX 1

ADULT GENERAL SELF-CONCEPT INVENTORY
AGSCI Subscales
Instructions

Please answer each item below by checking ( ) the most appropriate blank in the series. Consider this example:

Do you have trouble saying "no" to a sales person?
practically never __ __ __ __ __ __ __ very often
If you never or almost never have trouble saying "no" to a sales person you should check the last blank on the left, on the "practically never" side. If you always or very often have difficulty when faced with this kind of experience, you should check the farthest blank on the right. If you fall in between these two extremes, check the blank which you believe most applies to yourself that is between the two end points.

Take a reasonable amount of time to complete this form accurately, but do not spend too much time reflecting. Remember your initial reaction is often the most valid.
Note: Please answer the questions based on your thoughts and feelings since being in the hospital.

1. Do you think of yourself as a worthwhile person?
practically never__ __ __ __ __ __ __ very often
2. Do you feel unable to plan daily activities?
practically never__ __ __ __ __ __ __ very often
3. How much do you worry about whether other people will regard you as a success or a failure in your job or in school?
practically never__ __ __ __ __ __ __ very often
4. Do you often wish or fantasize that you were better looking?
practically never__ __ __ __ __ __ __ very often
5. How confident are you that your can understand the perspective of another person?
not very confident __ __ __ __ __ __ __ very confident
6. Do you think of yourself as more athletic than most people?
practically never__ __ __ __ __ __ __ very often
7. Do you often think of yourself as an outstanding worker?
practically never__ __ __ __ __ __ __ very often
8. Do you feel that you forget easily?
practically never__ __ __ __ __ __ __ very often
9. Most of the time, do you genuinely like yourself?
practically never __ __ __ __ __ __ __ very often
10. When you think that some people you meet might have an unfavorable opinion of you, how concerned or worried do you feel about it?
not at all worried __ __ __ __ __ __ __ very worried

11. Most of the time, are you easily distracted?
practically never__ __ __ __ __ __ __ very often
12. Do you often think that you are quite physically attractive?
practically never __ __ __ __ __ __ __ very often
13. Have you ever thought that you lacked the ability to do well at recreational activities involving coordination and physical agility?
practically never __ __ __ __ __ __ __ very often
14. Do you ever feel less capable that others in your career or occupation?
practically never __ __ __ __ __ __ __ very often
15. Have you thought that it always takes you a long time to learn new information?
practically never__ __ __ __ __ __ __ very often
16. Do you ever doubt that you are a worthy person?
practically never __ __ __ __ __ __ __ very often
17. How often do you feel concerned about what other people think of you?
practically never __ __ __ __ __ __ __ very often
18. Do you find it harder than most others to solve problems in your head?
practically never__ __ __ __ __ __ __ very often
19. How confident are you that others see you as physically appealing?
not very confident __ __ __ __ __ __ __ very confident
20. Have you ever felt inferior to most other people in athletic ability?
practically never __ __ __ __ __ __ __ very often
21. Do you think of yourself as someone that who can do quite well on work related assignments?
practically never __ __ __ __ __ __ __ very often
22. Do you think of yourself as a generally competent person who can do most things well?
practically never __ __ __ __ __ __ __ very often
23. Most of the time, do you consider yourself alert?
practically never__ __ __ __ __ __ __ very often
24. How much do you worry about criticisms that might be made of you by others?
not very much at all __ __ __ __ __ __ __ very much
25. Do you ever feel that you are less physically attractive than you would prefer to be?
practically never __ __ __ __ __ __ __ very often
26. When involved in sports requiring physical coordination, are you usually confident that you will do well?
practically never __ __ __ __ __ __ __ very often
27. Do you often think of yourself as an intelligent person?
practically never__ __ __ __ __ __ __ very often
28. Are you frequently concerned about your ability to do well on the job?
practically never __ __ __ __ __ __ __ very often

29. How often do you feel that you have a strong sense of self-respect?
practically never __ __ __ __ __ __ __ very often
30. How much do you worry about how well you get along with other people?
practically never __ __ __ __ __ __ __ very often
31. Do you ever think that your eye-hand coordination is better than most others?
practically never__ __ __ __ __ __ __ very often
32. Do you ever feel especially proud of, or pleased with your looks and appearance?
practically never __ __ __ __ __ __ __ very often
33. When trying to do well at a sport, how confident are you that your physical abilities will make it possible for you to do well?
practically never __ __ __ __ __ __ __ very often
34. Do you usually think of yourself as someone who can do quite well in handling job related tasks and responsibilities?
practically never __ __ __ __ __ __ __ very often
35. How often do you have trouble expressing your ideas?
practically never__ __ __ __ __ __ __ very often
Please make sure you have answered all the questions and THANK-YOU.

General Self= 1, 9, 16R, 22, 29
Social Acceptance= 3R, 10R, 17R, 24R, 30R
Physical Appearance= 4R, 12, 19, 25R, 32
Physical Ability= 6, 13R, 20R, 26, 33
Occupation Self Concept= 7, 14R, 21, 28R, 34
Cognitive Self Concept= 2R, 5, 8R, 11R, 15R, 18R, 23, 27, 31, 35R

APPENDIX 2
THE PATIENT COMPETENCY RATING SCALE
Patient Form

Instructions: The following is a questionnaire that asks you to judge your ability to do a variety of very practical skills. Some of the questions may not apply directly to things you often do, but you are asked to complete each question as if it were something you "had to do." On each question you should judge how difficult or easy a particular activity is for you and circle the appropriate number to the left of the question.
Note: The Staff Form is identical to that given to the patient with the additional instructions "NOTE STAFF: Please rate these questions based on your judgement of the patients ability."

USE THE FOLLOWING CODE

1 = Can't do
2 = Very difficult to do
3 = Can do with some difficulty
4 = Fairly easy to do
5 = Can do with ease

1. How much of a problem would it be to fix my own meals if I had to?
2. How much of a problem do I have in dressing myself?
3. How much of a problem would it be to take care of my personal hygiene?
4. How much of a problem would I have in washing dishes if I had to?
5. How much of a problem would it be to do my own laundry if I had to?
6. How much of a problem would I have in taking care of my finances if I had to?
7. How much of a problem do I have in keeping appointments on time?
8. How much of a problem would it be for me to start a conversation?
9. How much of a problem would it be for me to stay involved in work activities when I am bored or tired?
10. How much of a problem do I have in remembering what I had for dinner last night?
11. How much of a problem would it be for me to remember names of people that I see often?
12. How much of a problem do I have in remembering my daily schedule?
13. How much of a problem would it be to remember important things that I must do?
14. How much of a problem would I have driving a car if I had to?

15. How much of a problem do I have in getting help when I am confused?
16. How much of a problem would it be for me to adjust to unexpected changes?
17. How much of a problem do I have in handling arguments with people I know well?
18. How much of a problem is it for me to accept criticism from other people?
19. How much of a problem do I have in controlling crying?
20. How much of a problem would it be for me to act appropriately when I'm around friends, family, or staff?
21. How much of a problem would it be for me to show affection to people?
22. How much of a problem do I have in participating in group activities?
23. How much of a problem do I have in recognizing when something I say or do has upset someone else?
24. How much of a problem would it be for me to schedule my daily activities?
25. How much of a problem do I have in understanding new instructions?
26. How much of a problem would it be for me to consistently meet my daily responsibilities?
27. How much of a problem do I have in controlling my temper when something upsets me?
28. How much of a problem would it be for me to keep from being depressed?
29. How much of a problem do I have in keeping my emotions from affecting my ability to go about the day's affairs?
30. How much of a problem would it be for me to control my laughter?

APPENDIX 3

THE ROSENBERG SELF-ESTEEM SCALE

Please indicate how much you agree or disagree with each of the statements by circling a single number for each question, that represents how you typically feel most of the time (On the actual scale there are six boxes with the following scale above the spaces to provide a key).

STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE

1) On the whole, I am satisfied with myself.
2) At times I think I am no good at all.
3) I feel that I have a number of good qualities.
4) I am able to do things as well as most other people.
5) I feel I do not have much to be proud of.
6) I certainly feel useless at times.
7) I feel that I am a person of worth, at least on an equal plane with others.
8) I wish I could have more respect for myself.
9) All in all, I am inclined to feel that I am a failure.
10) I take a positive attitude toward myself.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Cynthia Beaulieu
Assistant Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Anthony F. Greene
Assistant Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Michael Crary
Professor of Communication Processes and Disorders

This dissertation was submitted to the Graduate Faculty of the College of Health Related Professions and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1995

Dean, College of Health Related Professions

Dean, Graduate School

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Bruce Crosson, Chair
Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Russell Bauer
Associate Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Eileen Fennell
Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Walter Cunningham
Professor of Psychology